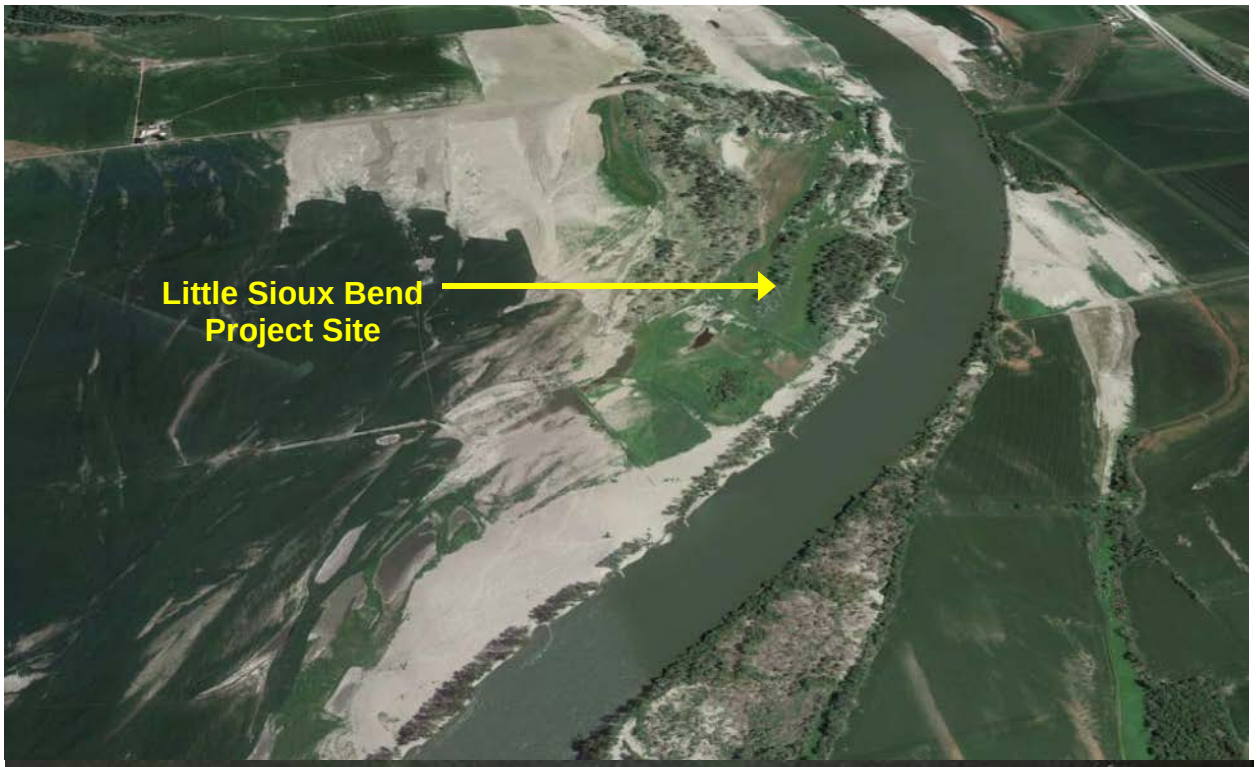
U.S. Army Corps of Engineers
Omaha District

Water Quality Sampling Report and Factual Determinations

Results of Sediment Sampling and Elutriate Testing at the Proposed Little Sioux Bend Shallow Water Habitat Project Site



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Water Quality Sampling Report
and
Factual Determinations

Results of Sediment Sampling and Elutriate Testing at the Proposed Little Sioux Bend Shallow Water Habitat Project Site

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1 BACKGROUND INFORMATION

1.1 Project Description

A project is being proposed to create shallow-water habitat (SWH) along the Missouri River in Harrison County, Iowa and Burt County, Nebraska. The U.S. Army Corps of Engineers (USACE) is constructing SWH along the lower Missouri River downstream of Gavins Point Dam to mitigate aquatic habitat lost from past bank stabilization and channelization. Increasing SWH will enhance the endangered pallid sturgeon (*Scaphirhynchus albus*) population along the lower Missouri River. The District is referring to the proposed project as the Little Sioux project. Hydraulic dredging would be used to excavate sediment/soil from an old chute area of the Missouri River to create SWH. The material to be dredged is believed to be primarily sands and silts with some clays. It is proposed that the dredge spoil be discharged to the Missouri River adjacent to the proposed project area.

1.2 Project Location

The project area is located in Harrison County, Iowa and Burt County, Nebraska along the Little Sioux Bend of the Missouri River between RM 666 and RM669. The project area is actually on the Nebraska side of Missouri River and will basically run down the old river channel that is the legal boundary between the States of Iowa and Nebraska (Figure 1). Figure 2 shows the proposed area for excavation to create SWH at the Little Sioux project area.

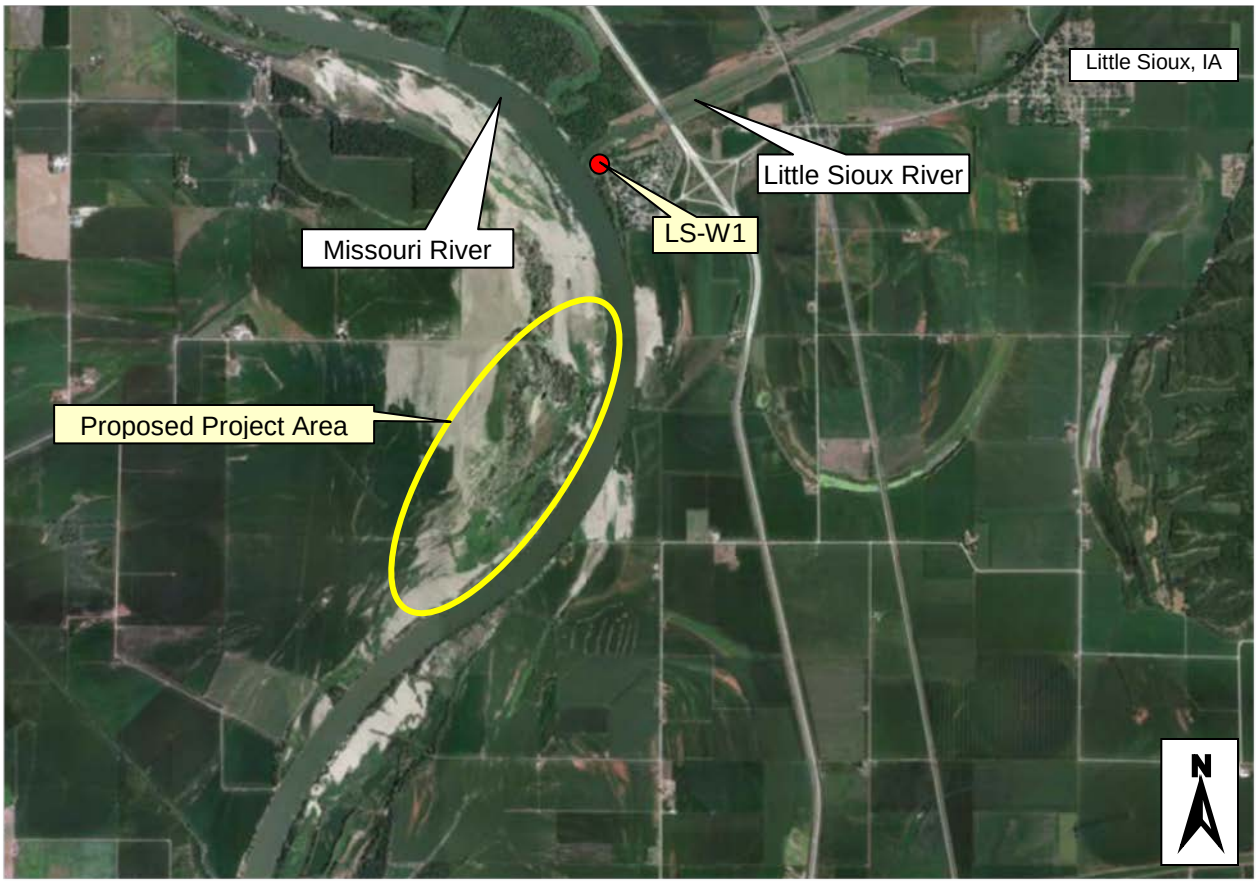

Figure 1. Location of proposed Little Sioux project site along the Missouri River west of Little Sioux, Iowa. *(Imagery Date: 18-July-2012, Google Earth)*

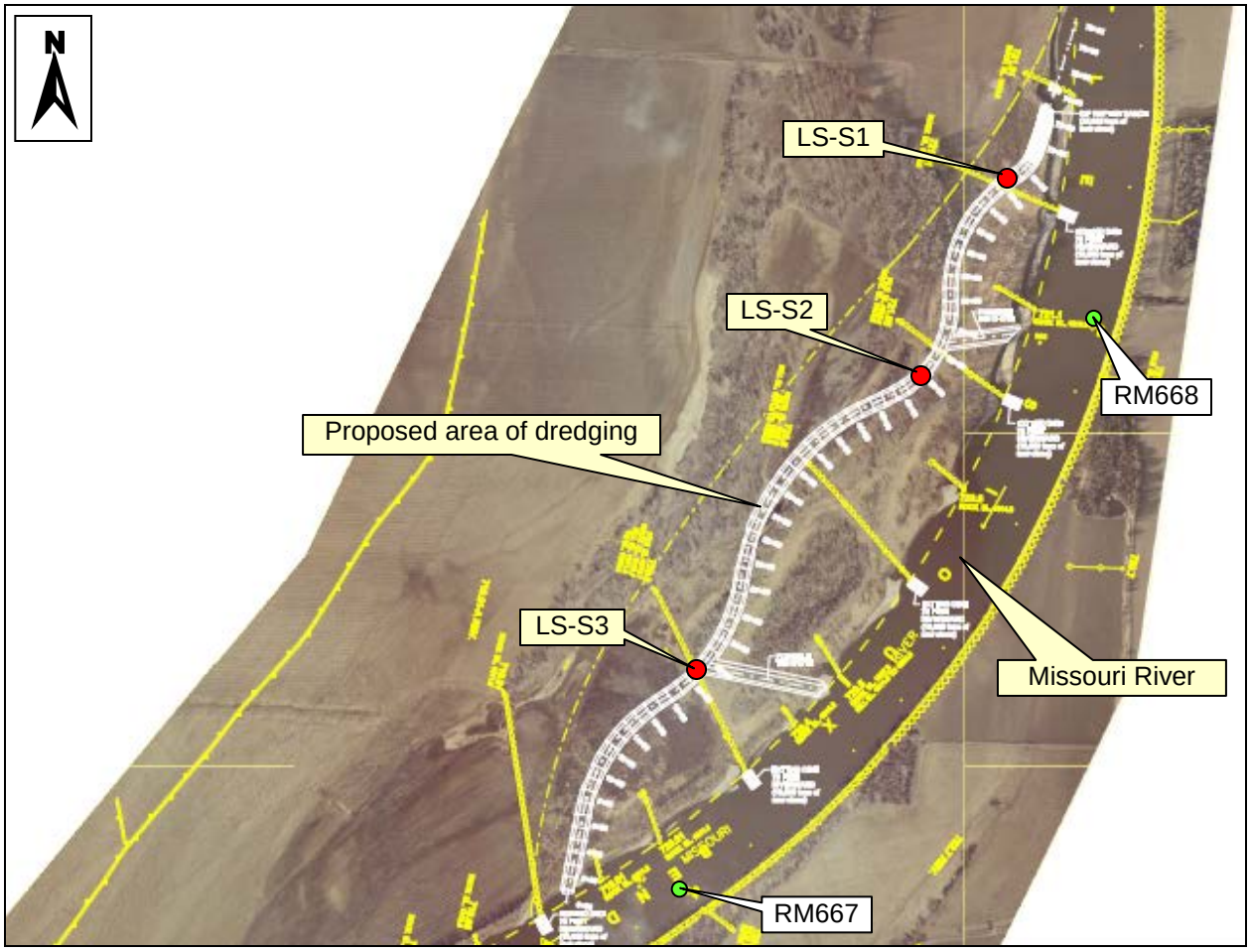

Figure 2. Proposed excavation to create shallow-water habitat at the Little Sioux project area.

1.3 Section 404 Permitting Requirements – 404(b)(1) Guidelines

Section 404 of the Federal Clean Water Act (CWA) requires that a §404 permit be appropriately obtained prior to the discharge of any dredge or fill material into waters of the United States. The issuance of §404 permits is pursuant to the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (404(b)(1) Guidelines) [40 CFR Ch. I (7-1-10 Edition)]. Fundamental to the 404(b)(1) Guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern. No discharge of dredged or fill material is permitted: 1) if it will cause or contribute, after consideration of disposal site dilution and dispersion, to violations of any applicable State water quality standard; 2) if it will cause or contribute to significant degradation of the waters of the United States; or 3) unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic system.

Compliance with the 404(b)(1) Guidelines is based, in part , on "Factual Determinations" of the potential impact of the proposed dredge and fill on the aquatic environment. The §404 permitting authority is required to determine in writing the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic

environment. These Factual Determinations are used in making findings of compliance or non-compliance with the restrictions on discharge. The 404(b)(1) Guidelines at §230.11 identify the following eight Factual Determinations that are to be made on the effects of each proposed discharge of dredge and fill material:

1) Physical substrate determinations.
2) Water circulation, fluctuation, and salinity determinations.
3) Suspended particulate/turbidity determinations.
4) Contaminant determinations.
5) Aquatic ecosystem and organism determinations.
6) Proposed disposal site determinations.
7) Determination of cumulative effects on the aquatic ecosystem.
8) Determination of secondary effects on the aquatic ecosystem.

The intent of this report is to provide Factual Determinations of the potential water quality impacts of hydraulic dredging discharge at the proposed Little Sioux project on the Missouri River. As defined in the Federal CWA and USACE Regulation No. 1110-2-8154, water quality is defined as the physical, chemical, and biological characteristics of water. This report specifically provides information for water quality Factual Determinations regarding:

- Physical substrate determinations,
- Suspended particulate/ turbidity determinations,
- Contaminant determinations,
- Proposed disposal site determinations.

The following describe the Factual Determinations that are to be made pursuant to the 404(b)(1) Guidelines regarding water quality impacts.

1.3.1 Physical Substrate Determinations

Determine the nature and degree of effect that the proposed discharge will have on the characteristics of the substrate at the proposed disposal site. Consideration shall be given to the similarity in particle size, shape, and degree of compaction of the material proposed for discharge and the material constituting the substrate at the disposal site, and any potential changes in substrate elevation and bottom contours, including changes outside of the disposal site which may occur as a result of erosion, slumpage, or other movement of the discharged material.

1.3.2 Suspended Particulate/Turbidity Determinations

Determine the nature and degree of effect that the proposed discharge will have in terms of potential changes in the kinds and concentrations of suspended particulate/turbidity in the vicinity of the disposal site. Consideration is to be given to the grain size of the material proposed for discharge, the shape and size of the plume of suspended particulates, the duration of the discharge and resulting plume and whether or not the potential changes will cause violations of applicable water quality standards.

1.3.3 Contaminant Determinations

Determine the degree to which the material proposed for discharge will introduce, relocate, or increase contaminants. This determination shall consider the material to be discharged, the aquatic environment at the proposed disposal site, and the availability of contaminants.

1.3.4 Proposed Disposal Site Determinations

The disposal site is specified through the application of the 404(b)(1) Guidelines. The mixing zone associated with the discharge is to be confined to the smallest practicable zone that is consistent with the type of dispersion determined to be appropriate. In a few special cases under unique environmental conditions, where there is adequate justification to show that widespread dispersion by natural means will result in no significantly adverse environmental effects, the discharged material may be intended to be spread naturally in a very thin layer over a large area of the substrate rather than be contained within the disposal site.

1.4 Section 401 Water Quality Certification

Under §401 of the Federal CWA an applicant for a federal license or permit (i.e. §404 permit) must obtain a certification that the discharge and activity is consistent with State or Tribal effluent limitations (CWA §301), water quality related effluent limitations (CWA §302), water quality standards and implementation plans (CWA §303), national standards of performance (§306), toxic and pretreatment effluent standards (CWA §307) and "any other appropriate requirement of State or Tribal law set forth in such certification." Regarding the Little Sioux project, a §401 water quality certification will be requested from the Iowa Department of Natural Resources (IDNR) and Nebraska Department of Environmental Quality (NDEQ) regarding compliance with State water quality standards and implementation plans. It is noted that the State of Iowa has recently released the Draft "Iowa Nutrient Reduction Strategy"; however, no nutrient management requirements have currently been promulgated. This report and water quality Factual Determinations will be provided to the IDNR and NDEQ to appropriately facilitate their water quality certification reviews pursuant to §401.

1.5 State Water Quality Standards Classifications of the Missouri River

1.5.1 Iowa

The State of Iowa designates the following uses to the Missouri River from the Iowa-Missouri state line to the confluence with the Big Sioux River: Primary Contact Recreation, Warmwater Type 1 Aquatic Life, and Human Health. The Missouri River at the Council Bluffs water works intake is also designated a use of raw water source of potable water supply. Pursuant to Iowa's antidegradation policy, the Missouri River in the vicinity of the proposed Little Sioux project is not identified as an outstanding State water (Tier 2 ½) or an outstanding National Resource Water (Tier 3). As appropriate, Iowa's antidegradation policy provides Tier 2 protection (existing water quality) to the Missouri River. Tier 1 protection (existing uses) applies and the State designated beneficial uses must be protected and associated numeric and narrative water quality criteria to protect these beneficial uses are not to be violated.

1.5.2 Nebraska

The State of Nebraska has designated the following uses to the entire length of the Missouri River in Nebraska: Primary Contact Recreation, Warmwater Aquatic Life Class A, Agricultural Water Supply, and Aesthetics. It has designated the use of public drinking water supply to the river downstream of the confluence of the Niobrara River, and industrial water supply to the river downstream of the confluence of the Big Sioux River. Nebraska has not identified the Missouri River in the vicinity of the Little Sioux project as a National or State Resource Water. As appropriate, Nebraska's antidegradation policy provides Tier 2 protection (existing water quality) to the Missouri River. Tier 1 protection (existing uses) applies and the State designated beneficial uses must be protected and associated numeric and narrative water quality criteria to protect these beneficial uses are not to be violated.

1.6 Use of Sediment/Soil Analysis, Elutriate Testing, and Ambient Missouri River Water Quality Data for Factual Determinations

Factual Determinations regarding potential water quality impacts from the proposed hydraulic dredging to construct SWH at the Little Sioux project was based on the analyses of representative sediment/soil samples collected from the proposed excavation area at the proposed project site. The collected sediment/soil samples were also subjected to elutriate testing pursuant to the Inland Testing Manual, "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (USEPA and USACE, 1998). Historic ambient water quality data collected along the Missouri River by the Omaha District were assessed.

2 SITE-SPECIFIC WATER QUALITY CONCERNS

2.1 Fish Consumption Advisory

The State of Nebraska had issued a fish consumption advisory for Dieldrin and PCBs on the Missouri River downstream of Gavins Point Dam. This advisory was based on the analysis of past fish tissue sampling that found levels of these substances at concentrations above the State's defined risk factor for protecting public health via fish consumption. However, the fish consumption advisory has recently been removed based on recent fish tissue sampling (NDEQ, 2012).

2.2 Section 303(d) Impaired Waters Listings

Section 303(d) of the Federal CWA requires States to evaluate water quality conditions in designated waterbodies, and list as impaired (i.e. 303(d) list) any waterbodies not meeting water quality standards. As appropriate, States must develop and implement Total Maximum Daily Loads –TMDLs (i.e. pollutant management plans) for waterbodies identified as impaired.

2.2.1 Iowa

Iowa has not listed the Missouri River in the area of the proposed Little Sioux project site on the State's most recent (i.e. 2010) 303(d) impaired waters list.

2.2.2 Nebraska

Nebraska's water quality standards identify the Missouri River from the Big Sioux River to the Platte River as designated Segment MT1-10000. Segment MT1-10000 is listed on Nebraska's 2012 Section 303(d) list as impaired due to a fish consumption advisory. The identified parameters of concern are Cancer Risk & Hazard Index Compounds, specifically, Dieldrin and PCBs. Previously, the State of Nebraska had indicated that due to the 303(d) listing of Segment MT1-10000 no dredged material can be discharged into the Missouri River unless concerns regarding Dieldrin and PCBs were addressed. Nebraska has promulgated acute and chronic surface water quality criteria for Dieldrin and PCBs. The acute and chronic criteria for Dieldrin are, respectively, 0.24 μg/L (concentration not to be exceeded at any time) and 0.00054 μg/L (24-hour average concentration). The acute and chronic criteria for PCBs are, respectively, 2.0 μg/L (concentration not to be exceeded at any time) and 0.00064 μg/L (24-hour average concentration). The chronic criteria for Dieldrin and PCBs are defined as human health criteria at the 10^{-5} risk level for carcinogens based on the consumption of fish and other aquatic organisms. Previously, Nebraska indicated that if levels of Dieldrin and PCBs determined from elutriate analysis of proposed dredge materials were found to be below the state water quality criteria this would meet potential concerns of the State regarding Dieldrin and PCBs in the discharge of dredged material. Thus,

past elutriate testing of collected sediment/soil samples along Segment MT1-10000 included analyzing Dieldrin and PCBs to a detection limit of 0.4 parts-per-trillion (i.e. 0.0004 μg/L).

After the sediment sampling and elutriate testing at the proposed Little Sioux project site was completed, the Nebraska Department of Environmental Quality (NDEQ) published the report, "Findings of the 2010 Regional Ambient Fish Tissue Program in Nebraska" (NDEQ, 2012). Findings in this report indicate that fish tissue samples collected from the Missouri River at Omaha and Rulo no longer contained harmful levels of Dieldrin and PCBs. As such, the State of Nebraska removed the fish consumption advisories for Dieldrin and PCBs from the Missouri River. This information became available after Nebraska's 2012 303(d) listing was published. Based on the removal of the fish consumption advisory for the Missouri River, the NDEQ has indicated that the 303(d) listing of the Missouri River for Dieldrin and PCBs will be removed in the next 303(d) listing published (personal communication NDEQ). As such, the Missouri River in the area of the proposed Little Sioux project site will not be identified as impaired by Nebraska's next 303(d) list of impaired waters.

2.3 Nutrients

2.3.1 Gulf of Mexico Hypoxia

A large area of the northern Gulf of Mexico is experiencing low dissolved oxygen or hypoxia during periods in the summer off the coasts of Louisiana and Texas. The hypoxia is primarily caused by excess nutrients – originating from cities, farms, and industries in the Mississippi River Basin – which cause extensive growths of algae that deplete the oxygen in the water when they die, sink to the bottom, and decompose. The condition is exacerbated by the stratification of the water column – result of warmer, low salinity surface waters that isolate the organic-rich bottom waters from the surface and prevent oxygen exchange with the atmosphere. Nutrient loading reduction targets of 45% of the current total nitrogen and total phosphorus riverine loads have been identified to achieve the goal for hypoxic zone size and to facilitate water quality improvements in the basin (MRGMWNTF, 2008).

The watershed of the Mississippi River drains 41 percent of the contiguous United States and includes waters from several major river systems, including the Missouri/Platte River Basin, the Ohio/Tennessee River Basin, and the Arkansas/Red/White River Basin. The Mississippi River Basin includes two functionally distinct zones, each with its own potential to contribute to Gulf hypoxia. These zones include the huge Mississippi watershed with its tributary network, and at the lower end of the river system, the deltaic zone that formerly dispersed river water naturally throughout Southeast Louisiana via a distributary (deltaic) network. While the tributaries of the Mississippi River are the sources of nutrient loading to the river trunk, the distributaries within the Mississippi Delta are critical to the final dispersal of nutrients and sediments into the Gulf of Mexico and the salinity of the estuaries and coastal waters. During the past two centuries the hydrology of the distributary zone was totally modified by the construction of flood levees, closing of key distributaries for flood control, and navigation enhancement programs. These structures isolated the river from its delta, causing an ongoing catastrophic collapse in the deltaic landscape, primarily wetlands. The hydrologic changes that have caused such damage to South Louisiana also exacerbate Gulf hypoxia by jetting most nutrient-rich river water and sediments directly into the Gulf of Mexico, bypassing the deltaic wetlands that captured the nutrients and sediments.

2.3.2 Iowa Nutrient Reduction Strategy

The 2008 Gulf Hypoxia Action Plan calls for the 12 states along the Mississippi River to develop strategies to reduce nutrient loading to the Gulf of Mexico (MRGMWNTF, 2008). In this regard, the State of Iowa has recently released a draft of the *"Iowa Nutrient Reduction Strategy – A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico"*

(IDALS et. al., 2012). The Iowa strategy follows the recommended framework provided by EPA in 2011, and is only the second state to complete a statewide nutrient reduction strategy. The Iowa Nutrient Reduction Strategy is a science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico. It is designed to direct efforts to reduce nutrients in surface water from both point and nonpoint sources in a scientific, reasonable and cost-effective manner. The Iowa strategy proposes a pragmatic, strategic and coordinated approach for reducing nutrient loads discharged from the state's largest wastewater treatment plants, in combination with targeted practices designed to reduce loads from nonpoint sources now while evaluating the future need for nutrient water quality standards.

For Iowa streams, EPA's recommended water quality standards' criteria range is from 0.712 to 3.26 mg/L for total N and from 0.070 to 0.118 mg/L total P (IDALS et.al., 2012). If these nutrient criteria recommendations were adopted as Iowa water quality standards, cities would be required to pay for expensive wastewater treatment plant upgrades that would address only a fraction of the overall amount of nutrients discharged to Iowa's streams while leaving wastewater treatment facilities unable to comply with permit limits (IDALS et.al., 2012). If compliance with stringent numeric effluent limits on point source discharges did not eliminate an existing impairment, the receiving stream would continue to exceed the water quality standard and would require development of a total maximum daily load (TMDL). At that point, any further reduction required by a TMDL would need to be accomplished through voluntary controls placed only on nonpoint sources. Because of the lack of confidence in EPA's recommended criteria and substantial financial costs associated with implementing nutrient removal technologies, legitimate concerns about the value of numeric nutrient criteria have been raised (IDALS, et.al., 2012). Other criteria derivation approaches such as nutrient stressor-response analysis and reference condition modeling are better alternatives that Iowa will continue assessing as a basis for appropriate nutrient standards for implementation within an adaptive watershed management framework (IDALS et.al, 2012).

2.4 National Research Council of the National Academies Assessment of Missouri River Water Quality and Sediment Management

USACE's SWH and emergent sandbar habitat (ESH) projects are directly depositing sediment into the mainstem Missouri River. Concerns have been expressed regarding the potential water quality impacts of those projects downstream and into the northern Gulf of Mexico. The following questions were tasked to the National Research Council regarding water quality and sediment management in the Missouri River:

- *What is the significance of the Missouri River sediments to the Gulf of Mexico Hypoxia problem?*
- *What are the key environmental and economic considerations regarding nutrient loads and/or contaminants in Missouri River Sediment? To what extent can such issues be addressed with management strategies?*

The following discussion and conclusions are taken from the document, "Missouri River Planning – Recognizing and Incorporating Sediment Management" prepared by the National Research Council (NRC, 2011).

Excess nitrogen loads are responsible for the long-term increase in the hypoxic area in the northern Gulf of Mexico; however, recent studies suggest that phosphorus may also be contributing to hypoxia, especially near the mouths of the Mississippi and Atchafalaya Rivers during the spring. The USACE's construction of SWH projects will result in releases of both nitrogen and phosphorus to the Missouri River because much of the topsoil portion of the sediment disposed of in the river has been heavily fertilized.

The NRC further assessed the situation based on total nitrogen (TN) and total phosphorus (TP) levels representative of excavated sediment/soil at SWH project sites and current TN and TP loads in the Missouri River and delivered to the Gulf of Mexico. It was concluded that the TN loads from constructed SWH projects will be insignificant compared to the current TN loads transported in the Missouri River and to the Gulf. Phosphorus loadings to the Missouri River from these projects, however, are likely to constitute a much greater fraction of the current load than additional nitrogen loadings. An upper-bound estimate of the increase in TP loadings to the Gulf of Mexico as a result of all potential SWH projects is a 6 to 12 percent increase. This estimate represents an upper bound assuming all sediment is delivered to the Gulf. In reality, sediment deposition processes in the Missouri and lower Mississippi river channels would reduce loads delivered downstream and eventually to the Gulf of Mexico. A comparison of potential phosphorus loads from USACE's SWH projects, with load increments required to produce measurable changes in the areal extent of Gulf hypoxia, showed these projects will not significantly change the extent of the hypoxic area in the Gulf of Mexico.

3 SAMPLING AND ANALYSIS METHODS

Sediment/soil samples, representative of the areas to be excavated for SWH construction at the proposed Little Sioux project site, were collected, analyzed, and subjected to elutriate testing. The results were used to assess the potential water quality impacts that the discharge from hydraulic dredging at the proposed project site would have on the Missouri River.

3.1 Sampling and Analysis Plan

A Sampling and Analysis Plan (SAP) was developed to collect sediment/soil samples at the proposed Little Sioux project site and conduct elutriate testing of the collected samples. The SAP was developed in consultation with the Iowa Department of Natural Resources and the Nebraska Department of Environmental Quality. The SAP was implemented as written with no modifications and is included as Attachment 1. The parameters that were measured in the field and analyzed in the laboratory for the different collected samples and elutriate testing are listed in Table 1. Analytical methods are provided in the attached SAP (Attachment 1).

3.2 Collection of Sediment/Soil Samples

Three sediment/soil samples were collected at the proposed Little Sioux project site for analysis and elutriate testing on 9-May-2012. The locations where the sediment/soil samples were collected are shown on Figures 2 and 3 and described in Tables 2 and 3. The sediment samples at each of the three sites were collected with a gas-powered auger equipped with a 2-in diameter stainless steel coring bit. Core samples were collected to a depth of 4 feet and composited. One gallon of the composited sediment/soil material was collected and transported to the laboratory for analysis and elutriate testing.

3.3 Collection of Receiving Water

In accordance with the "*Inland Testing Manual*", receiving water was collected from the Missouri River for elutriate testing. Receiving water measurements and samples were collected from the Missouri River at the Little Sioux, Iowa boat ramp approximately 1 mile upstream of the proposed Little Sioux project site. The receiving water sampling site, LP-W1, is shown on Figure 1. The mean daily flow of the Missouri River on 9-May-2012 when the receiving water sample was collected was 34,800 cfs (USGS gauging station 06601200).

Table 1. Parameters measured in the field and analyzed in the laboratory for the different media assessed.

Parameter	Sample Analysis			
	Soil	**Receiving Water**	**Pre-Elutriate Water**	**Elutriate Water**
Field Measurements:				
Water Temperature (°C)		✓		
pH (S.U)		✓		
Dissolved Oxygen (mg/l, % saturation)		✓		
Conductivity (umhos/cm)		✓		
Turbidity (NTU)		✓		
Laboratory Analysis:				
Carbonaceous Biochemical Oxygen Demand - CBOD (mg/L)		✓		✓*
Chemical Oxygen Demand - COD (mg/L)		✓		✓
Nitrogen, Ammonia as N, Total (mg/kg, mg/L)	✓	✓		✓*
Nitrogen, Total Kjeldahl as N (mg/kg, mg/L)	✓	✓	Calculated	✓*
Nitrogen, Nitrate/Nitrite as N (mg/kg, mg/L)	✓	✓	Calculated	✓
Nitrogen, Total as N (mg/L)		Calculated	Calculated	Calculated*
Organic Carbon, Total - TOC (mg/kg, mg/L)	✓	✓		✓*
Particle Size (% composition)	✓			
Percent Solids (%)	✓			
pH (S.U.)	✓	✓		✓
Phosphorus, Dissolved (mg/L)		✓		✓
Phosphorus, Total (mg/kg, mg/L)	✓	✓	Calculated	✓*
Metals Scan - Dissolved (µg/L)**		✓		✓
Metals - Total (mg/kg) (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc)	✓			
Organochlorine Pesticide and PCB Scan (µg/kg)	✓			
Organochlorine Pesticide and PCB Scan (µg/L)		✓		✓*
Organochlorine Pesticide – Dieldrin, Low-Level (µg/L)		✓		✓*
PCBs, Low-Level (µg/L)		✓		✓*
Total Suspended Solids (mg/L)		✓	Calculated	✓*
Turbidity (NTU)		✓		✓*

***** Determined on supernatant prior to filtration.

** Dissolved metals scan includes: Aluminum, Antimony, Arsenic, Beryllium, Cadmium, Calcium, Chromium III, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc.

Figure 3. Locations where sediment/soil samples were collected at the proposed Little Sioux project site on 9-May-2012. *(Site locations shown on 18-July-2012 Google Earth aerial photo of the project area.)*

Table 2. Sediment/soil samples collected at the proposed Little Sioux project site for elutriate testing

Sample Type	Sample ID	Sampled Depth	Collection Time	Sampling Method
Sediment/Soil	LS-S1	0 - 4 feet	14:00	Composite Core
Sediment/Soil	LS-S2	0 - 4 feet	13:20	Composite Core
Sediment/Soil	LS-S3	0 - 4 feet	12:40	Composite Core

Table 3. Geo-referenced locations where sediment/soil samples were collected for elutriate testing at the proposed Little Sioux project site.

Site	Latitude	Longitude
LS-S1	41° 47’ 20.0”	96° 03’ 55.7”
LS-S2	41° 47’ 04.3”	96° 04’ 04.4”
LS-S3	41° 46’ 41.4”	96° 04’ 24.4”

Note: GPS device used for determining locations was Garmin Map 76.

3.4 Elutriate Testing

The process that is currently followed by the Omaha District to prepare samples for elutriate testing from the sediment/soil samples collected at the proposed SWH project sites is depicted in Figure 4. The process was revised in November 2102 with the reintroduction of the pre-elutriate sample preparation and analysis. Pre-elutriate sample preparation and analysis was previously included as part of the elutriate testing process during the period 2004 through 2006 at the request of the IDNR.

3.4.1 Elutriate Samples

Elutriate samples were prepared in accordance with the "*Inland Testing Manual*", and were prepared by using receiving water collected from the Missouri River at site LS-W1. The sample was prepared in the laboratory by sub-sampling approximately 1-liter of the collected sediment/soil sample from the well-mixed original sample. The sediment material and unfiltered receiving water were then combined in a sediment-to-water ratio of 1:4 on a volume basis at room temperature (22 ± 2°C). The 1:4 sediment-to-water ratio is believed to represent "end-of-pipe" discharge conditions for hydraulic dredging. After the correct ratio was achieved, the mixture was stirred vigorously for 30 minutes with a mechanical stirrer/shaker. After the 30-minute mixing period, the mixture is allowed to settle for one hour. The supernatant was then siphoned off without disturbing the settled material. Analysis for total constituents was done on the supernatant without filtration, and the supernatant was filtered through a 0.45-micron filter for analysis of dissolved constituents. The filtered water is the standard elutriate sample identified by the *"Inland Testing Manual"* and represents the dissolved constituents that could be released from dredged material during the hydraulic dredging process.

3.4.2 Pre-Elutriate Samples

Pre-elutriate samples were not prepared and directly analyzed as part of the elutriate testing done on the sediment/soil samples collected at the proposed Little Sioux project. Total nutrient concentrations representative of pre-elutriate conditions were estimated from measured percent solids and total nutrient levels measured in the collected sediment/soil samples. Other elutriate testing studies at proposed SWH projects along the Missouri River in the Omaha District where pre-elutriate samples were prepared and analyzed were used to estimate the total suspended solids (TSS) concentration for a typical pre-elutriate sample. The estimated, typical TSS concentration for a pre-elutriate sample was then used to estimate total nutrient concentrations for pre-elutriate conditions based on the analyzed conditions of the sediment/soil samples collected at the proposed Little Sioux project site.

3.4.3 Metal Analysis

The metals Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, and Zinc were identified as parameters of concern by either the State of Iowa or Nebraska.

3.4.3.1 Sediment/Soil Samples

Collected sediment/soil samples were directly analyzed for total levels of the eight identified metals.

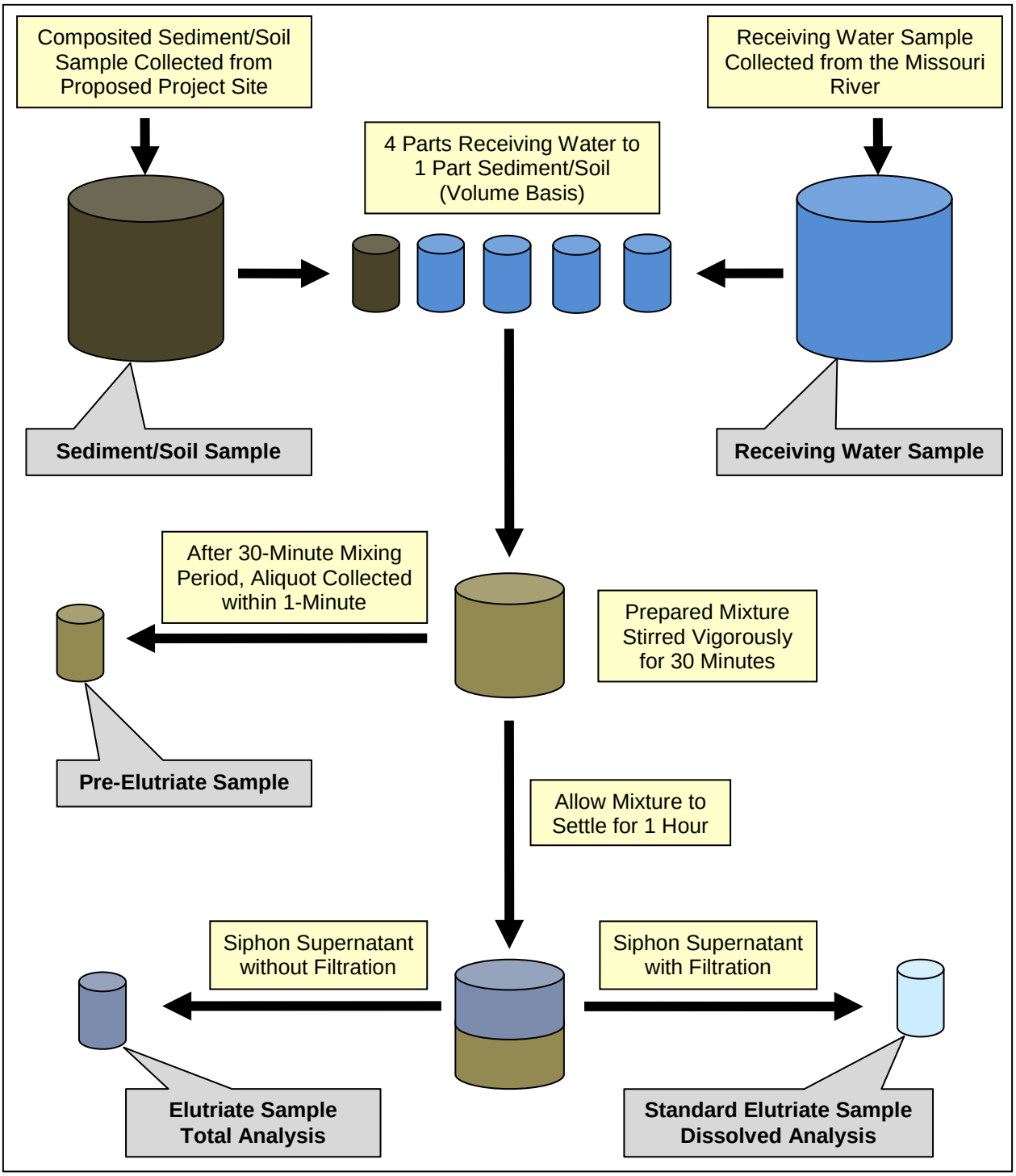

Figure 4. Revised process currently followed by the Omaha District to prepare samples for elutriate testing from collected sediment/soil samples (revisions implemented November, 2012).

3.4.3.2 Receiving Water and Elutriate Samples

Water samples (i.e. receiving water, elutriate) were analyzed for dissolved metals only. Iowa and Nebraska's water quality standards for selected metals are hardness-based. Iowa's metals criteria are based on "total recoverable" concentrations which is not directly measured by the standard elutriate testing (i.e. the final step of the standard elutriate test is filtration which results in dissolved metals being measured). The Iowa total recoverable metals criteria were compared to the results of the analysis of the Standard Elutriate samples which are a dissolved metals concentrations. Nebraska's metals criteria, other than the chronic criterion for mercury are based on dissolved concentrations. The hardness of the Missouri River (i.e. receiving water) at the time the sediment/soil samples were collected was determined from measured dissolved calcium and magnesium levels: hardness (mg/L) = 2.497(Ca) + 4.118(mg) = 310 mg/L. The District has monitored ambient water quality conditions of the Missouri River at Decatur, NE (RM691) over the 10-year period 2003 through 2012. Based on 34 quarterly measurements, hardness (mg/L) ranged from 232 to 381, averaged 272, and had a median of 266.

4 RESULTS

4.1 Receiving Water

The receiving water used for the elutriate testing was collected from the Missouri River at site LS-W1. Water quality conditions of the receiving water measured in the field at the time of collection were: Water Temperature, 17.5°C; Dissolved Oxygen, 8.1 mg/l and 87.5% saturation; pH, 8.3 S.U.; Specific Conductance, 813 µS/cm; and Turbidity, 1,400 NTU. As indicated by the measured turbidity level, the Missouri River and collected receiving water was extremely turbid due to ongoing tributary runoff. Laboratory analyses of collected receiving water are provided in Attachment 3.

4.2 Particle Size Analysis

The collected sediment/soil samples were analyzed for particle size using Method ASTM D422. The Particle Size Distribution Reports for the analyzed sediment/soil samples collected at the proposed Little Sioux project site are provided in Attachment 2. Table 4 and Figure 5 summarize the particle size percent composition of the collected sediment/soil samples. The collected sediment/soil samples ranged from 58.8% to 69.3% fines and 30.4% to 44.4% sand. None of the three collected sediment/soil samples contained material of a grain size greater than sand (Table 4).

Table 4. Summary of particle size analysis of the sediment/soil samples collected at the proposed Little Sioux project site.

		% Gravel		% Sand			% Fines	
Sample ID	**% Cobbles**	**Coarse**	**Fine**	**Coarse**	**Medium**	**Fine**	**Silt**	**Clay**
LS-S1	0.0	0.0	0.0	0.0	2.7	27.7	47.5	22.1
LS-S2	0.0	0.0	0.0	0.0	0.4	44.4	39.3	15.9
LS-S3	0.0	0.0	0.0	0.0	0.1	41.1	45.1	13.7
MEAN	**0.0**	**0.0**	**0.0**	**0.0**	**1.1**	**37.7**	**44.0**	**17.2**

See Attachment 2 for defination of particle sizes.

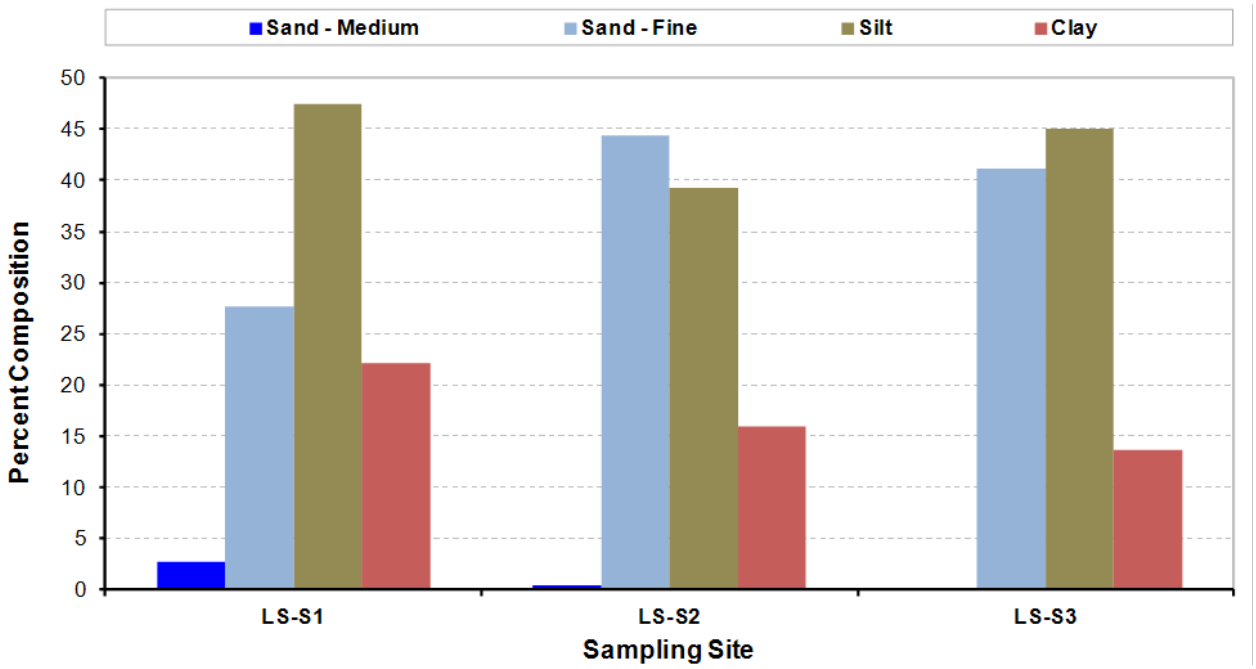

Figure 5. Particle size percent composition of sediment/soil samples collected at sites LS-S1, LS-S2, and LS-S3.

4.3 Physiochemical Analysis of Sediment/Soil and Receiving Water Samples and Elutriate Testing Results

The laboratory report of the analyses of the sediment/soil, receiving water, and elutriate samples is provided as Attachment 3. The following summarizes these results and their application to Iowa and Nebraska water quality standards.

4.3.1 Analyzed Constituents with Promulgated State Water Quality Standards

The following constituents were analyzed and have numeric water quality standards criteria promulgated by the State of Iowa or Nebraska:

- Ammonia Nitrogen
- Dieldrin (Low-Level)
- Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc)
- Nitrate/Nitrite Nitrogen
- Organochlorine Pesticides (Scan)
- PCBs (Low-Level)
- Polychlorinated Biphenyls – PCBs (Scan)
- pH

4.3.1.1 Ammonia Nitrogen

Constituent: Ammonia Nitrogen					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (mg/L)	Dissolved (mg/L)	Non-Filtered Total Analysis (mg/L)	Standard Dissolved Analysis (mg/L)
LS-S1	73	0.08J	0.08J	0.09J	0.09J
LS-S2	54	0.08J	0.08J	0.68	0.67
LS-S3	18	0.08J	0.08J	0.09J	0.09J
MEAN	**48.3**	-----	-----	**0.287**	**0.283**

Detection and Reporting Limits – Ammonia as N:

Sediment/Soil = 0.2 mg/kg and 1 mg/kg; Water = 0.02 mg/L and 0.1 mg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

For application of water quality standards criteria for ammonia, field measured pH and temperature of the Missouri River when sediment/soil samples collected were 8.3 S.U and 17.5°C, respectively.

IOWA WATER QUALITY STANDARDS – Ammonia as N; Use Class B(WW-1)

Constituent	Acute Standard	Chronic Standard
Ammonia (Total as N) *Early Life Stages Present* *pH = 8.3, Temperature (°C) = 17.5*	4.71 mg/L	1.26 mg/L

NEBRASKA WATER QUALITY STANDARDS – Ammonia as N; Warmwater Aquatic Life Class A

Constituent	Acute Standard	Chronic Standard
Ammonia (Total as N) *Early Life Stages Present* *pH = 8.3, Temperature (°C) = 17.5*	4.71 mg/L	1.26 mg/L

Comparison of Ammonia Elutriate Tests to Water Quality Standards

Both the Iowa and Nebraska acute and chronic ammonia criteria (i.e. 4.71 and 1.26 mg/L) for the Missouri River were the same based on the ambient water quality conditions of the Missouri River measured at the time the sediment/soil samples were collected. All non-filtered and filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute and chronic criteria for ammonia. The highest elutriate test for ammonia was 0.68 mg/L.

4.3.1.2 Dieldrin (Low-Level)

Constituent: Dieldrin (Low-Level)					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (μg/kg)	Total (μg/L)	Dissolved (μg/L)	Non-Filtered Total Analysis (μg/L)	Standard Dissolved Analysis (μg/L)
LS-S1	n.d.	n.d.		n.d.	
LS-S2	n.d.	n.d.		n.d.	
LS-S3	n.d.	n.d.		n.d.	

Detection and Reporting Limits – Dieldrin:

Sediment/Soil = 0.0003 and 9.9 μg/kg; Water = 0.0002 μg/L and 0.001 μg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Dieldrin; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Dieldrin	0.24 μg/L	0.056 μg/L	0.00054 μg/L

NEBRASKA WATER QUALITY STANDARDS – Dieldrin; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Dieldrin	0.24 μg/L	0.00054 μg/L	0.00052 μg/L

Comparison of Dieldrin Elutriate Tests to Water Quality Standards

All non-filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were non-detectable for Dieldrin (Low-Level) and were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water criteria for Dieldrin. The highest elutriate test for Dieldrin (Low-Level) was non-detect.

4.3.1.3 Metals – Arsenic

Constituent: Metals - Arsenic					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	n.d.		3		4
LS-S2	n.d.		3		6
LS-S3	n.d.		3		7
MEAN	-----		-----		**5.7**

Detection and Reporting Limits – Arsenic: Sediment/Soil = 1 mg/kg and 5 mg/kg; Water = 1 µg/L and 3 µg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Arsenic; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Arsenic	340 µg/L	150 µg/L	50 µg/L

NEBRASKA WATER QUALITY STANDARDS – Arsenic; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Arsenic	340 µg/L	16.7 µg/L	10 µg/L

Comparison of Arsenic Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water criteria for arsenic. The highest elutriate test for dissolved arsenic was 7 µg/L.

4.3.1.4 Metals – Cadmium

Constituent: Metals - Cadmium					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	1.23J		n.d.		n.d.
LS-S2	0.99J		n.d.		n.d.
LS-S3	0.71J		n.d.		n.d.

Detection and Reporting Limits – Cadmium: Sediment/Soil = 0.5 mg/kg and 2 mg/kg; Water = 0.2 µg/L and 1 µg/L.
n.d. = Non-detect.
J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Cadmium; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Cadmium *Hardness = 310 mg/L*	6.7 µg/L	0.63 µg/L	168 µg/L

NEBRASKA WATER QUALITY STANDARDS – Cadmium; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Cadmium *Hardness = 310 mg/L*	18 µg/L	0.54 µg/L	5 µg/L

Comparison of Cadmium Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water criteria for Cadmium. The highest elutriate test for dissolved Cadmium was non-detect.

4.3.1.5 Metals – Chromium III

Constituent: Metals - Chromium III					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	13.6		9J		9J
LS-S2	12.0		9J		9J
LS-S3	10.5		9J		15
MEAN	**12.0**		-----		**11.0**

Detection and Reporting Limits – Chromium III:

Sediment/Soil = 0.2 mg/kg and 1 mg/kg; Water = 4 µg/L and 10 µg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Chromium III; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Chromium III	N/A	N/A	N/A

NEBRASKA WATER QUALITY STANDARDS – Chromium III; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Chromium III *Hardness = 310 mg/L*	1,496 µg/L	195 µg/L	100 µg/L

Comparison of Chromium III Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Nebraska acute, chronic, and public drinking water criteria for Chromium III. The highest elutriate test for dissolved Chromium III was 15 µg/L.

4.3.1.6 Metals – Copper

Constituent: Metals - Copper					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	14.9		4J		11
LS-S2	13.0		4J		9J
LS-S3	8.4		4J		15
MEAN	**12.1**		-----		**11.7**

Detection and Reporting Limits – Copper: Sediment/Soil = 0.2 mg/kg and 1 mg/kg; Water = 2 µg/L and 10 µg/L.
n.d. = Non-detect.
J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Copper; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Copper *Hardness = 310 mg/L*	41 µg/L	25 µg/L	1,000 µg/L

NEBRASKA WATER QUALITY STANDARDS – Copper; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Copper *Hardness = 310 mg/L*	39 µg/L	24 µg/L	1,000 µg/L

Comparison of Copper Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water criteria for Copper. The highest elutriate test for dissolved Copper was 15 µg/L.

4.3.1.7 Metals – Lead

Constituent: Metals - Lead					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	9.4		n.d.		n.d
LS-S2	7.5		n.d.		5
LS-S3	6.2		n.d.		7
MEAN	**7.7**		----		**4.2**

Detection and Reporting Limits – Lead: Sediment/Soil = 1 mg/kg and 5 mg/kg; Water = 0.5 µg/L and 2 µg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Lead; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Lead *Hardness = 310 mg/L*	345 µg/L	13 µg/L	N/A

NEBRASKA WATER QUALITY STANDARDS – Lead; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Lead *Hardness = 310 mg/L*	216 µg/L	8.4 µg/L	N/A

Comparison of Lead Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute and chronic criteria for Lead. The highest elutriate test for dissolved lead was 7 µg/L.

4.3.1.8 Metals – Mercury

Constituent: Metals - Mercury					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	n.d.		n.d.		n.d.
LS-S2	n.d.		n.d.		n.d.
LS-S3	n.d.		n.d.		n.d.

Detection and Reporting Limits – Mercury:

Sediment/Soil = 0.2 mg/kg and 1 mg/kg; Water = 0.02 µg/L and 0.05 µg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Mercury; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Mercury	1.64 µg/L	0.90 µg/L	0.15 µg/L

NEBRASKA WATER QUALITY STANDARDS – Mercury; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking water Standard
Mercury	1.40 µg/L	0.77 µg/L	2 µg/L

Comparison of Mercury Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water criteria for Mercury. The highest elutriate test for dissolved Mercury was non-detect.

4.3.1.9 Metals – Nickel

Constituent: Metals - Nickel					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	17.2		8J		15
LS-S2	15.4		8J		12
LS-S3	13.5		8J		21
MEAN	**15.4**		-----		**16.0**

Detection and Reporting Limits – Nickel: Sediment/Soil = 0.2 mg/kg and 1 mg/kg; Water = 2 µg/L and 10 µg/L.
n.d. = Non-detect.
J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Nickel; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Nickel *Hardness = 310 mg/L*	1,222 µg/L	136 µg/L	4,600 µg/L

NEBRASKA WATER QUALITY STANDARDS – Nickel; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Nickel *Hardness = 310 mg/L*	1,219 µg/L	135 µg/L	610 µg/L

Comparison of Nickel Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water for Nickel. The highest elutriate test for dissolved Nickel was 21 µg/L.

4.3.1.10 Metals – Zinc

Constituent: Metals - Zinc					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	52.8		53		62
LS-S2	45.1		53		66
LS-S3	33.8		53		56
MEAN	**43.9**		-----		**61.3**

Detection and Reporting Limits – Zinc: Sediment/Soil = 1 mg/kg and 5 mg/kg; Water = 4 µg/L and 10 µg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Zinc; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Zinc *Hardness = 310 mg/L*	313 µg/L	313 µg/L	26,000 µg/L

NEBRASKA WATER QUALITY STANDARDS – Zinc; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
Zinc *Hardness = 310 mg/L*	306 µg/L	306 µg/L	5,000 µg/L

Comparison of Zinc Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water criteria for Zinc. The highest elutriate test for dissolved Zinc was 66 µg/L.

4.3.1.11 Nitrate/Nitrite Nitrogen

Constituent: Nitrate/Nitrite Nitrogen					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (mg/L)	Dissolved (mg/L)	Non-Filtered Total Analysis (mg/L)	Standard Dissolved Analysis (mg/L)
LS-S1	4.8		1.2		2.1
LS-S2	2.8		1.2		1.1
LS-S3	2.8		1.2		1.7
MEAN	**3.47**		-----		**1.63**

Detection and Reporting Limits – Nitrate/Nitrite Nitrogen:

Sediment/Soil = 0.2 mg/kg and 1 mg/kg; Water = 0.02 mg/L and 0.05 mg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – Nitrate/Nitrite Nitrogen; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
Nitrate-Nitrite Nitrogen	N/A	N/A	N/A

NEBRASKA WATER QUALITY STANDARDS – Nitrate/Nitrite Nitrogen; Agricultural Water Supply and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Agricultural Water Supply	Public Drinking Water Standard
Nitrate/Nitrite Nitrogen	N/A	N/A	100 mg/L	10 mg/L

Comparison of Nitrate/Nitrite Nitrogen Elutriate Tests to Water Quality Standards

All filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were less than the Nebraska agricultural water supply and public drinking water criteria for Nitrate/Nitrite Nitrogen. The highest elutriate test for Nitrate/Nitrite Nitrogen was 2.1 mg/L.

4.3.1.12 Organochlorine Pesticide Scan

Constituent: Organochlorine Pesticide Scan					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (µg/L)	Dissolved (µg/L)	Non-Filtered Total Analysis (µg/L)	Standard Dissolved Analysis (µg/L)
LS-S1	n.d.	n.d.		n.d.	
LS-S2	n.d.	n.d.		n.d.	
LS-S3	n.d.	n.d.		n.d.	

Detection and Reporting Limits – Organochlorine Pesticide Scan:

20 different pesticides were analyzed with varying detection and reporting levels – see Appendix 2.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

Iowa Water Quality Standards – Organochlorine Pesticides; Use Class B(WW-1), Human Health – Fish Consumption

Nebraska Water Quality Standards – Organochlorine Pesticides; Warmwater Aquatic Life Class A and Human Health (Fish Consumption)

Organochlorine Pesticide	Acute Standard (µg/L)	Chronic Standard (µg/L)	Human Health Criterion (µg/L)
Aldrin	3	0.0005	0.0005
BHC	100	0.414	0.414
BHC (Alpha)	-----	0.049	0.049
BHC (Beta)	-----	0.17	0.17
Chlordane	2.4	0.0043	-----
DDT	1.1	0.001	-----
DDD	0.6	0.0031	0.0031
DDE	1,050	0.0022	0.0022
Dieldrin	0.24	0.00054	0.00054
Endosulfan (Alpha)	0.22	0.056	-----
Endosulfan (Beta)	0.22	0.056	-----
Endosulfan sulfate	-----	89	89
Endrin	0.086	0.036	-----
Endrin aldehyde	-----	0.30	0.30
Heptachlor	0.52	0.00079	0.00079
Heptachlor epoxide	0.52	0.00039	0.00039
Lindane	0.95	0.16	-----

Comparison of Organochlorine Pesticide Scan Elutriate Tests to Water Quality Standards

All elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were non-detectable for the Organochlorine Pesticides included in the Scan. Some of the Iowa and Nebraska's water quality standards for the scanned pesticides were below the detection limits of the scan.

4.3.1.14 Polychlorinated Biphenyls (PCBs) – Low-Level

Constituent: PCBs (Low-Level)					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (μg/kg)	Total (μg/L)	Dissolved (μg/L)	Non-Filtered Total Analysis (μg/L)	Standard Dissolved Analysis (μg/L)
LS-S1	n.d.	n.d.		n.d.	
LS-S2	n.d.	n.d.		n.d.	
LS-S3	n.d.	n.d.		n.d.	

Detection and Reporting Limits – PCBs:

Sediment/Soil = 0.009 – 0.02 and 50 μg/kg; Water = 0.0002 – 0.0004 μg/L and 0.001 μg/L.

n.d. = Non-detect.

J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

IOWA WATER QUALITY STANDARDS – PCBs; Use Class B(WW-1), Human Health – Fish Consumption

Constituent	Acute Standard	Chronic Standard	Human Health Standard
PCBs	2 μg/L	0.014 μg/L	0.00064 μg/L

NEBRASKA WATER QUALITY STANDARDS – Dieldrin; Warmwater Aquatic Life Class A and Public Drinking Water

Constituent	Acute Standard	Chronic Standard	Public Drinking Water Standard
PCBs	2 μg/L	0.00064 μg/L	0.00064 μg/L

Comparison of PCBs Elutriate Tests to Water Quality Standards

All non-filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were non-detectable for PCBs (Low-Level) and were less than the Iowa and Nebraska acute, chronic, human health, and public drinking water criteria for PCBs. The highest elutriate test for PCBs (Low-Level) was non-detect.

4.3.1.15 pH

Constituent: pH					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (S.U.)	Field (S.U.)	Lab (S.U.)	Non-Filtered Total Analysis (S.U.)	Standard Dissolved Analysis (S.U.)
LS-S1	8.1	8.3	8.3	8.2	
LS-S2	7.7	8.3	8.3	7.7	
LS-S3	8.3	8.3	8.3	7.9	

Detection and Reporting Limits – pH: Sediment/Soil and Water = 0.1 S.U. and 0.2 S.U.

IOWA WATER QUALITY STANDARDS – pH; Use Class B(WW-1)

Constituent	Minimum Standard	Maximum Standard
pH	6.5 S.U.	9.0 S.U.

NEBRASKA WATER QUALITY STANDARDS – pH; Warmwater Aquatic Life Class A

Constituent	Minimum Standard	Maximum Standard
pH	6.5 S.U.	9.0 S.U.

Comparison of pH Elutriate Tests to Water Quality Standards

Both the Iowa and Nebraska minimum and maximum pH criteria (i.e. 6.5 and 9.0 mg/L) for the Missouri River are the same. The pH of all non-filtered elutriate tests of the 3 collected sediment/soil samples at the proposed Little Sioux project site were within the minimum and maximum pH criteria.

4.3.2 Analyzed Constituents with No Promulgated State Water Quality Standards

The following constituents were analyzed and have no numeric water quality standards criteria promulgated by the State of Iowa or Nebraska:

- Carbonaceous Biochemical Oxygen Demand, 5-Day ($CBOD_5$)
- Chemical Oxygen Demand (COD)
- Kjeldahl Nitrogen, Total (TKN)
- Percent Solids
- Total Organic Carbon (TOC)
- Total Phosphorus
- Total Suspended Solids
- Turbidity

4.3.2.1 Carbonaceous Biochemical Oxygen Demand (5-day)

Constituent: $CBOD_5$					
		Receiving Water (Missouri River)		**Elutriate Water**	
Sample Location	**Sediment/Soil (mg/kg)**	**Total (mg/L)**	**Dissolved (mg/L)**	**Non-Filtered Total Analysis (mg/L)**	**Standard Dissolved Analysis (mg/L)**
LS-S1		2J		n.d.	
LS-S2		2J		n.d.	
LS-S3		2J		n.d.	

Detection and Reporting Limits – $CBOD_5$: Water = 2 mg/L and 5 mg/L.
n.d. = Non-detect.
J = Estimated Value (Reported Value > Detection Limit and < Reporting Limit).

4.3.2.2 Chemical Oxygen Demand

Constituent: COD					
		Receiving Water (Missouri River)		**Elutriate Water**	
Sample Location	**Sediment/Soil (mg/kg)**	**Total (mg/L)**	**Dissolved (mg/L)**	**Non-Filtered Total Analysis (mg/L)**	**Standard Elutriate (mg/L)**
LS-S1		19	16	18	16
LS-S2		19	16	13	16
LS-S3		19	16	16	13
MEAN		**-----**	**----**	**15.7**	**15.0**

Detection and Reporting Limits – COD: Water = 3 mg/L and 10 mg/L.

4.3.2.3 Total Kjeldahl Nitrogen

Constituent: TKN					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (mg/L)	Dissolved (mg/L)	Non-Filtered Total Analysis (mg/L)	Standard Dissolved Analysis (mg/L)
LS-S1	580	1.8	1.1	1.4	1.1
LS-S2	383	1.8	1.1	1.4	1.1
LS-S3	293	1.8	1.1	1.5	1.0
MEAN	**419**	-----	-----	**1.43**	**1.07**

Detection and Reporting Limits – TKN: Sediment/Soil = 2 mg/L and 10 mg/L; Water = 0.2 mg/L and 0.5 mg/L.

4.3.2.4 Percent Solids

Constituent: Percent Solids					
Sample Location	Sediment/Soil (%)				
LS-S1	71.3				
LS-S2	73.6				
LS-S3	84.6				

Detection and Reporting Limits – Percent Solids: Sediment/Soil = 0.01% and 1%.

4.3.2.5 Total Organic Carbon

Constituent: TOC					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (mg/L)	Dissolved (mg/L)	Non-Filtered Total Analysis (mg/L)	Standard Dissolved Analysis (mg/L)
LS-S1	8,800	13.5		7.4	4.4
LS-S2	7,900	13.5		7.6	4.5
LS-S3	3,700	13.5		9.6	4.4
MEAN	**6,800**	-----		**8.20**	**4.43**

Detection and Reporting Limits – TOC: Sediment/Soil = 2 mg/L and 10 mg/L; Water = 0.2 mg/L and 1 mg/L.

4.3.2.6 Total Phosphorus

Constituent: Total Phosphorus (TP)					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (mg/L)	Dissolved (mg/L)	Non-Filtered Total Analysis (mg/L)	Standard Dissolved Analysis (mg/L)
LS-S1	383	0.27	0.10	0.30	0.14
LS-S2	506	0.27	0.10	0.16	0.10
LS-S3	419	0.27	0.10	0.27	0.14
MEAN	**436**	-----	-----	**0.243**	**0.127**

Detection and Reporting Limits – TP: Sediment/Soil = 0.2 mg/L and 1 mg/L; Water = 0.02 mg/L and 0.05 mg/L.

4.3.2.7 Total Suspended Solids

Constituent: Total Suspended Solids (TSS)					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Total (mg/L)	Dissolved (mg/L)	Non-Filtered Total Analysis (mg/L)	Standard Dissolved Analysis (mg/L)
LS-S1		362		136	
LS-S2		362		149	
LS-S3		362		249	
MEAN		-----		**178**	

Detection and Reporting Limits – TSS: Water = 4 mg/L and 10 mg/L.

4.3.2.8 Turbidity

Constituent: Turbidity					
		Receiving Water (Missouri River)		Elutriate Water	
Sample Location	Sediment/Soil (mg/kg)	Field Measured (NTU)	Lab Measured (NTU)	Non-Filtered Total Analysis (NTU)	Standard Dissolved Analysis (NTU)
LS-S1		1,400	206	207	n.d.
LS-S2		1,400	206	207	n.d.
LS-S3		1,400	206	246	n.d.
MEAN		-----	-----	**220**	**n.d.**

Detection and Reporting Limits – Turbidity: Water = 1 NTU and 3 NTU.

4.4 Estimated Pre-Elutriate Sample Conditions

Pre-elutriate sample conditions were estimated based on nutrient and percent solids analyses of collected Little Sioux sediment/soil samples and the 4-to-1 water-to-sediment dilution factor used for elutriate testing. In 2004, pre-elutriate samples were prepared and analyzed for total suspended solids (TSS) at the proposed Tyson Bend, Soldier Bend, and California Bend SWH project sites. In 2012, pre-elutriate samples were prepared and analyzed for TSS at the proposed Glovers Point SWH project site. The TSS analyses of the Tyson Bend, Soldier Bend, California Bend, and Glovers Point prepared pre-elutriate samples were used to estimate a typical (i.e. mean) TSS concentration for a pre-elutriate sample prepared from sediment/soil collected at a SWH project site (Table 5). Table 6 gives the percent solids and total nutrient concentrations measured in the sediment/soil samples collected at the proposed Little Sioux project site. Table 7 gives estimated mean pre-elutriate total nutrient concentrations based on the collected Little Sioux sediment/soil samples and estimated TSS conversion factor.

Table 5. Total suspended solids concentrations for pre-elutriate samples prepared from sediment/soil samples collected at the Tyson Bend, Soldier Bend, California Bend, and Glovers Point shallow-water habitat project sites.

Sediment/Soil Sample	Total Suspended Solids (mg/L)	Total Suspended Solids (kg/L)
Tyson Bend 1	17,000	
Tyson Bend 2	11,000	
Tyson Bend 3	6,300	
Soldier Bend 1	7,100	
Soldier Bend 2	17,000	
Soldier Bend 3	7,300	
California Bend 1	40,000	
California Bend 2	12,000	
California Bend 3	12,000	
Glovers Point 1	51,100	
Glovers Point 2	6,027	
Glovers Point 3	10,825	
Glovers Point 4	20,267	
Mean	**16,763 mg/L**	**0.016763 kg/L**
Median	**12,000 mg/L**	**0.012000 kg/L**
Minimum	**6,027 mg/L**	**0.006027 kg/L**
Maximum	**51,100 mg/L**	**0.051100 kg/L**

Table 6. Percent solids and nutrient concentrations measured in sediment/soil samples collected at the proposed Little Sioux project site.

Sampling Site	Percent Solids	Ammonia N (mg/kg)		Total Kjeldahl N (mg/kg)		Total P (mg/kg)	
		Wet Wt.	Dry Wt.	Wet Wt.	Dry Wt.	Wet Wt.	Dry Wt.
LP-S1	71.3%	73	102	580	813	383	537
LP-S2	73.6%	54	73	383	520	506	688
LP-S3	84.6%	18	21	293	346	419	495
Mean	**76.5%**	**48.3**	**65.7**	**419**	**560**	**436**	**573**

Table 7. Estimated mean pre-elutriate nutrient concentrations based on the collected Little Sioux sediment/soil samples and estimated TSS conversion factor.

Sample Type	TSS Conversion Statistic	TSS Conversion Factor (kg/L)	Total Ammonia	Total Kjeldahl N	Total Phosphorus
Average Sediment (Wet)	-----	-----	48.3 mg/kg	419 mg/kg	436 mg/kg
Estimated Pre-Elutriate (Wet)	Mean	0.016763	0.81 mg/L	7.0 mg/L	7.31 mg/L
Average Sediment (Dry)	-----	-----	65.7 mg/kg	560 mg/kg	573 mg/kg
Estimated Pre-Elutriate (Dry)	Mean	0.016763	1.10 mg/L	9.4 mg/L	9.61 mg/L

5 WATER QUALITY FACTUAL DETERMINATIONS

5.1 Physical Substrate Determinations

Table 4 and Figure 5 described the particle size composition of the material identified for excavation for the construction of SWH at the proposed Little Sioux project site. A mean particle size composition for the material identified for excavation at the proposed Little Sioux site was calculated from the three collected sediment samples. The material to be excavated is believed to be alluvial material.

As part of Bank Stabilization and Navigation Project (BSNP), the Omaha District irregularly samples substrate composition in the navigation channel of the Missouri River. In 2008, particle size composition of the river bottom was measured every 5 miles from Ponca, NE to Rulo, NE. At each location three substrate samples were collected from the navigation channel. Table 8 shows the particle size composition of the substrate samples collected from the navigation channel upstream and downstream of the proposed Little Sioux project (RM668) site at RM670 and RM665. The substrate particle size composition in the navigation channel of the Missouri River indicates that the finer material has been washed out and transported downstream. This is in line with the management goals of the BSNP to maintain the navigation channel. Depth-discrete water quality sampling in the navigation channel of the lower Missouri River by the Omaha District indicates that the water column is completely mixed except for a restricted area near the river bottom where bed-load is transported.

Table 8. Summary of particle size analysis of the sediment samples collected from the Missouri River navigation channel at RM670 and RM665 during 2008.

		% Gravel		% Sand			% Fines	
Sample Location	**% Cobbles**	**Coarse**	**Fine**	**Coarse**	**Medium**	**Fine**	**Silt**	**Clay**
RM670 - 70163	0.0	0.0	9.5	8.2	39.6	42.5	0.2	
RM670 - 70164	0.0	0.0	0.1	0.1	36.1	63.4	0.3	
RM670 - 70165	0.0	0.0	3.0	6.2	55.7	34.9	0.2	
MEAN RM670	**0.0**	**0.0**	**4.2**	**4.8**	**43.8**	**46.9**	**0.2**	
RM665 - 70166	0.0	0.0	0.2	0.7	50.5	45.3	0.3	
RM665 - 70167	0.0	0.0	3.4	10.2	46.2	39.7	0.5	
RM665 - 70168	0.0	0.0	0.0	0.0	4.8	94.9	0.3	
MEAN RM665	**0.0**	**0.0**	**1.2**	**3.6**	**33.8**	**60.0**	**0.4**	

Figure 6 plots the mean particle size composition of the sediment samples collected at the proposed Little Sioux project site and from the navigation channel of the Missouri River at RM670 and RM665. As seen in Figure 6, there are significantly more fines in the sediment identified for excavation at the proposed Little Sioux project site as compared to the bottom substrate of the Missouri River navigation channel. This is not unexpected given that the existing sediment at the Little Sioux project site is finer alluvial material that settled out along the river benches during higher flows. As occurs with sediment delivered from inflowing tributaries, the finer material in the proposed dredging discharge will be transported downstream as part of the suspended solids load, and the heavier material will be incorporated into the Missouri River bed-load.

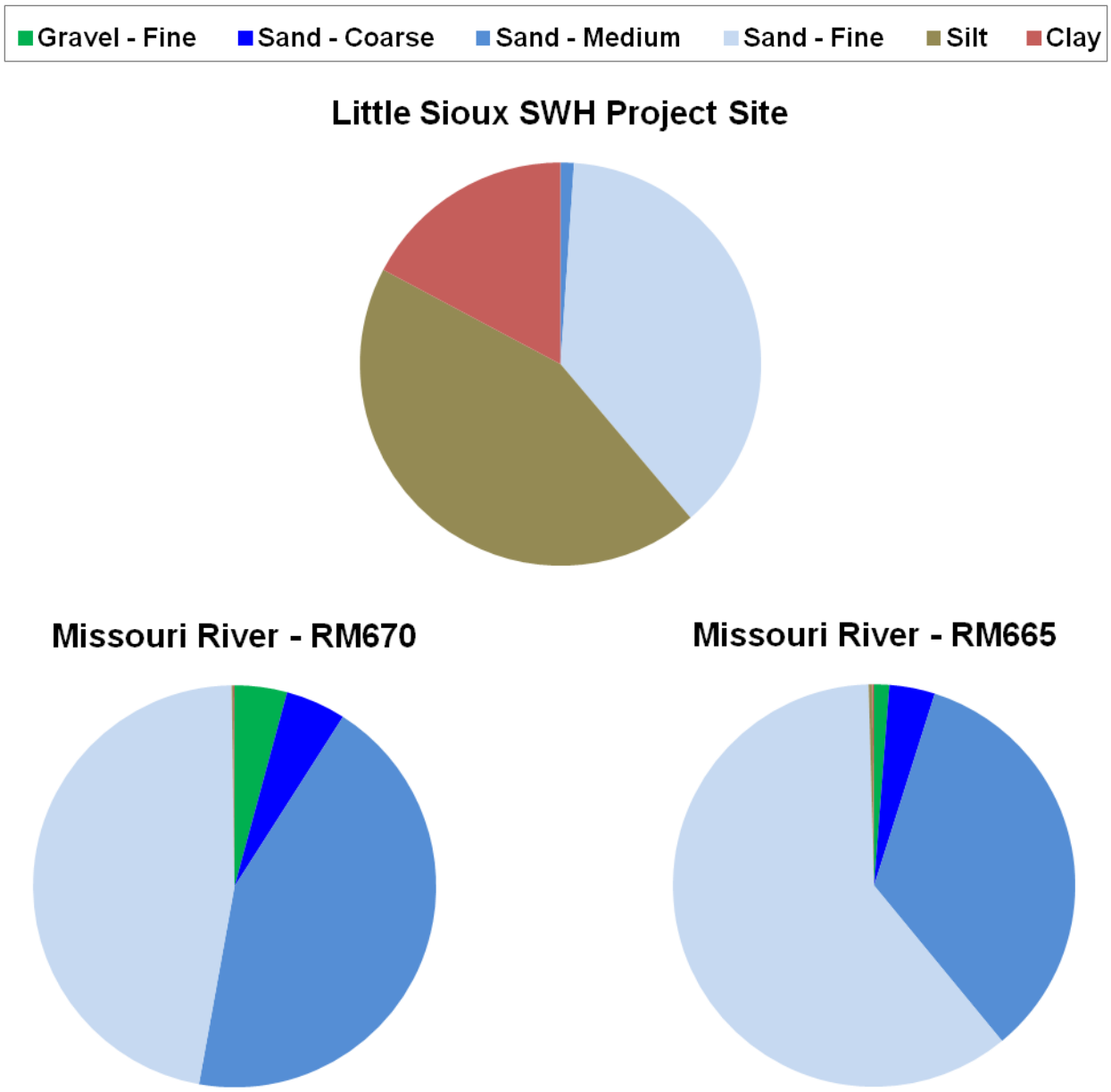

Figure 6. Particle size composition of likely dredge material at the proposed Little Sioux project site and the substrate of the Missouri River bottom in the navigation channel in the area of the proposed Little Sioux project.

5.2 Suspended Particulate/Turbidity Determinations

The dredge slurry discharge at the "end-of-pipe" will have a high total suspended solids (TSS) concentration and be quite turbid. As shown in Table 5, analysis of pre-elutriate samples prepared during elutriate testing at other SWH project sites along the Missouri River indicate TSS concentrations ranging from 6,000 mg/L to 51,100 mg/L (average 16,700 mg/L) can be expected in the dredging discharge at the "end-of-pipe". Turbidity measurements of prepared pre-elutriate samples indicated turbidity levels up to 8,000 NTUs could be expected at the "end-of-pipe". Some local impacts to existing Missouri River water quality from TSS and turbidity can be expected in the immediate vicinity (i.e. "end-of-pipe") of the dredging discharge.

Past dredging discharges to construct SWH have attempted to minimize any such impacts by targeted placement of the dredging discharge in the Missouri River (e.g. mid-channel, mid-depth, etc.). The Omaha District assessed in-river TSS and turbidity levels upstream and downstream of the dredging discharge during construction of SWH at the California Bend project site. Four sites were monitored: 1) upstream of the "end-of-pipe", 2) zone of initial dilution at the dredging discharge, 3) 200 feet downstream of the "end-of-pipe" in the discharge plume, and 4) 2,000 feet downstream of the "end-of-pipe in the discharge plume. Table 9 gives TSS and turbidity levels measured at the four locations during dredging discharge in September 2003. Figure 7 plots the same information. As seen in Table 9 and Figure 7, TSS and turbidity levels are elevated in the zone of initial dilution; however, these levels quickly dissipate downstream in the discharge plume.

Table 9. Total suspended solids and turbidity levels monitored in the Missouri River upstream and downstream of the dredging discharge to construct shallow-water habitat at the California Bend project site in 2003.

	Upstream of Discharge		Zone of Initial Dilution		200 Feet Downstream		2,000 Feet Downstream	
Date	TSS (mg/L)	Turbidity (NTUs)	TSS (mg/L)	Turbidity (NTUs)	TSS (mg/L)	Turbidity (NTUs)	TSS (mg/L)	Turbidity (NTUs)
5-Sep-03	46	30	331	218	81	90	29	38
12-Sep-03	84	43	629	414	144	94	74	56

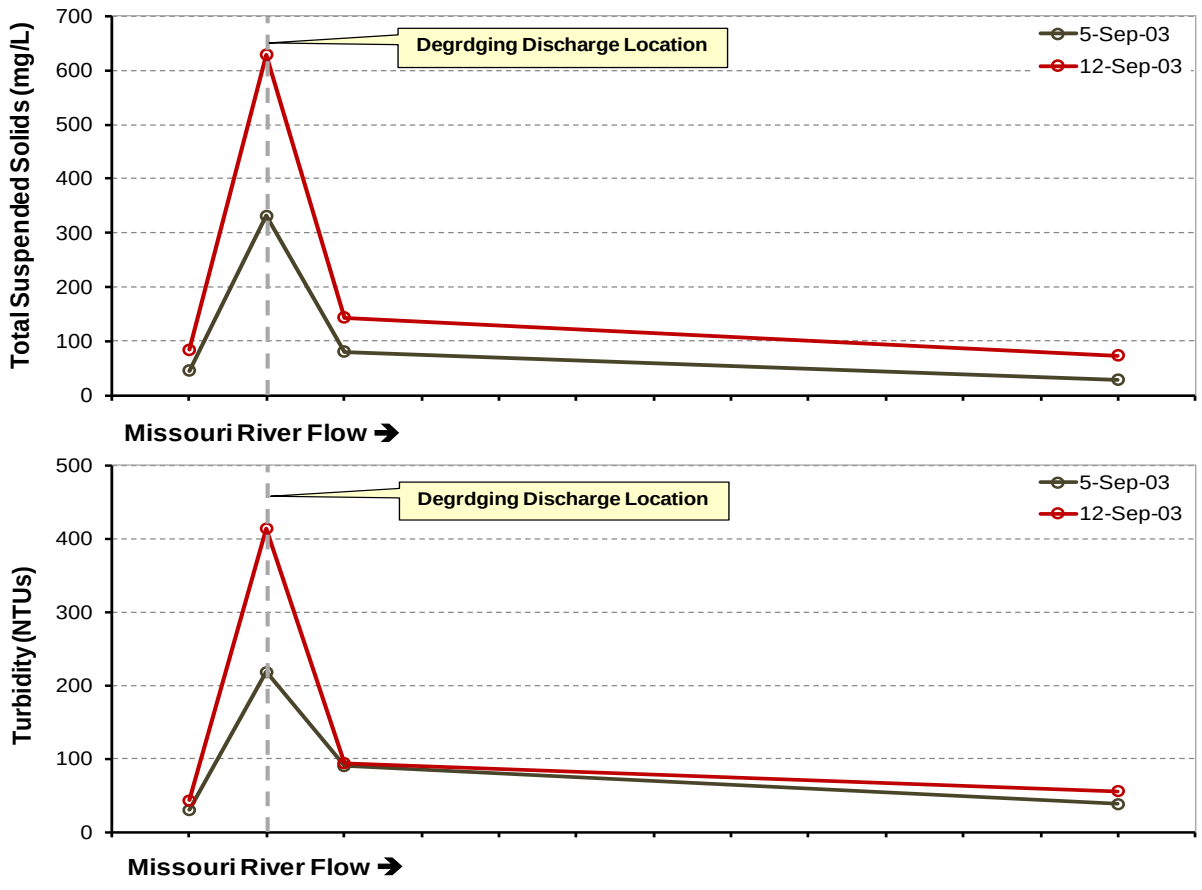

Figure 7. Total suspended solids and turbidity levels monitored in the Missouri River upstream and downstream of the dredging discharge to construct shallow-water habitat at the California Bend project in 2003.

5.3 Contaminant Determinations

5.3.1 Constituents with Promulgated State Water Quality Standards' Numeric Criteria

Elutriate testing of representative sediment/soil samples collected at the proposed Little Sioux project included analysis of the following constituents that the States of Iowa or Nebraska have promulgated water quality standards numeric criteria: Ammonia; Dieldrin; Metals, Arsenic, Cadmium, Chromium III, Copper, Lead, Mercury, Nickel, Zinc; Nitrate/Nitrite; Organochlorine Pesticides; PCBs; and pH. None of the prepared elutriate samples exceeded promulgated State water quality standards criteria.

5.3.2 Nutrients

5.3.2.1 Potential Dredging Discharge Flows

The following information was taken from EM 1110-2-5025 (25-Mar-1983), "*Dredging and Dredged Material Disposal*" (USACE, 1983):

> "The hydraulic pipeline cutterhead suction dredge … is equipped with a rotating cutter apparatus surrounding the intake end of the suction pipe, it can effectively dig and pump all types of alluvial materials and compacted deposits, such as clay and hardpan. Slurries of 10 to 20 percent solids (by dry weight) are typical, depending upon the material being dredged, dredging depth, horsepower of dredge pumps, and pumping distance to disposal area. If no other data are available, a pipeline discharge concentration of 13 percent by dry weight (145 ppt) should be used for design purposes. Pipeline discharge velocity, under routine working conditions, ranges from 15-20 ft/sec. Table 10 presents theoretical pipeline discharge rates as functions of pipeline discharge velocity for dredges ranging from 8 to 30 in."

Table 10. Suction dredge pipeline discharge rates (cfs)[(a)] [taken from EM 1110-2-5025].

	Discharge Pipe Diameter			
Discharge Velocity (ft/sec)	**8-inch**	**18-inch**	**24-inch**	**30-inch**
10	3.5	17.7	31.4	49.1
15	5.2	26.5	47.1	73.6
20	7.0	35.3	62.8	98.1
25	8.7	44.2	78.5	122.7

(a) Discharge rate = pipeline area x discharge velocity.
Discharge rate for 20-inch diameter pipe:
Pipe radius = 10 in. = 0.833 ft.
Pipe area = $\pi r^2 = (3.1416)(0.833)^2 = 2.18$ ft^2
Discharge rate = 2.18 ft^2 x 20 ft/sec = 43.6 cfs
Note: Given a velocity of 20 ft/sec was used, this is a maximum estimate for discharge rate.

5.3.2.2 Elutriate Testing of Sediment/Soil Samples Collected at the Little Sioux Site

Elutriate testing of the sediment/soil samples collected at the proposed Little Sioux project site was done pursuant to the "*Inland Testing Manual*". A test slurry was prepared based on a dilution of 1 part sediment to 4 parts receiving water on a volume basis. The 1:4 dilution for elutriate testing represents a 20% slurry. However, elutriate testing is done using "wet" sediment to avoid volatilization of any potential contaminants in the sediment during a drying process. The "wet" sediment was analyzed for percent solids and the amount of water present in the sediment sample can be mathematically

converted to "dry weight" based on the percent solids quantification. Table 11 estimates the dry-weight percent slurries for each of the elutriate mixtures prepared from the three sediment/soil samples collected from the proposed Little Sioux project site. The percent slurry estimate is based on the measured percent solids of the collected sediment/soil samples and the 1:4 dilution used to prepare elutriate samples. All of the prepared elutriate mixtures from the collected sediment/soil samples fall within the 10 to 20 percent solids (by dry weight) typically for a hydraulic pipeline cutterhead suction dredge.

Table 11. Dry-weight percent slurries represented by the elutriate mixtures prepared from the three sediment/soil samples collected at the proposed Little shallow-water habitat site.

Sediment/Soil Sample	Percent Solids	Percent Slurry (Based on Estimated Dry Weight)
LS-S1	71.3%	14.3%
LS-S2	73.6%	14.7%
LS-S3	84.6%	16.9%

Note: Based on a 1:4 (dry-weight sediment to water ratio):
- 100% percent solids = 20% slurry
- 50% percent solids = 10% slurry

5.3.2.3 Missouri River Nutrient Conditions at Little Sioux Bend Area on 9-May-2012

Tables 12, 13, and 14, respectively, summarize the nutrient concentrations, fluxes, and loadings present in the Missouri River on 9-May-2012 when sediment/soil samples were collected at the proposed Little Sioux project site.

Table 12. Nutrient concentrations measured in the Missouri River at RM669 on 9-May-2012.

Total Kjeldahl N (mg/L)	Ammonia N (mg/L)	Nitrate-Nitrite N (mg/L)	Total P (mg/L)	Dissolved P (mg/L)
1.8	0.08	1.20	0.27	0.10

Table 13. Estimated nutrient fluxes in the Missouri River at RM669 on 9-May-2012 based on measured nutrient concentrations and recorded mean daily flow of 34,800 cfs.

Flow (cfs)	Total Kjeldahl N (kg/sec)	Ammonia N (kg/sec)	Nitrate-Nitrite N (kg/sec)	Total P (kg/sec)	Dissolved P (kg/sec)
34,800	1.8909	0.0840	1.2606	0.2836	0.1051

Table 14. Estimated nutrient loadings in the Missouri River at RM669 on 9-May-2012 based on estimated nutrient fluxes.

Flow (cfs)	Total Kjeldahl N (tons/day)	Ammonia N (tons/day)	Nitrate-Nitrite N (tons/day)	Total P (tons/day)	Dissolved P (tons/day)
34,800	180.09	8.00	120.06	27.01	10.01

5.3.2.4 Missouri River Mean Nutrient Conditions at Little Sioux Area

Mean nutrient conditions were determined for the Missouri River at the Little Sioux area from monthly water quality sampling of the river by the Omaha District at Decatur, NE (RM691) over the 5-year period 2007 through 2011 (Table 15).

Table 15. Mean nutrient concentrations measured in the Missouri River at Decatur, NE (RM691) by the Omaha District over the 5-year period 2007 through 2011.

Total Kjeldahl N (mg/L)	Ammonia N (mg/L)	Nitrate-Nitrite N (mg/L)	Total N (mg/L)	Total P (mg/L)	Dissolved P (mg/L)
1.0	0.09	1.14	2.1	0.21	0.07

The average mean daily flow of the Missouri River was determined at Decatur, NE (RM691) based on the period of record (1988 - 2012) mean daily flows recorded at the USGS's Decatur gauge (06601200). The average mean daily flow of the Missouri River at Decatur, NE was determined to be 31,719 cfs (range = 7,070 - 189,000 cfs; median = 28,500 cfs). The mean daily flow of 31,719 cfs was used to determine nutrient fluxes and loadings based on the monthly Missouri River water quality conditions monitored by the Omaha District over the 5-year period 2007 through 2011 (Table 15). Tables 16 and 17, respectively, summarize the mean nutrient fluxes and loadings for the Missouri River at the Little Sioux area.

Table 16. Estimated mean nutrient fluxes in the Missouri River at Decatur, NE (RM691).

Flow (cfs)	Total Kjeldahl N (kg/sec)	Ammonia N (kg/sec)	Nitrate-Nitrite N (kg/sec)	Total N (kg/sec)	Total P (kg/sec)	Dissolved P (kg/sec)
31,719	0.8982	0.0808	1.0239	1.8861	0.1886	0.0629

Table 17. Estimated mean nutrient loadings in the Missouri River at Decatur, NE (RM691) based on estimated mean nutrient fluxes.

Flow (cfs)	Total Kjeldahl N (tons/day)	Ammonia N (tons/day)	Nitrate-Nitrite N (tons/day)	Total N (tons/day)	Total P (tons/day)	Dissolved P (tons/day)
31,719	85.54	7.70	97.52	179.63	17.96	5.99

5.3.2.5 Estimations of Nutrient Loadings from Proposed Hydraulic Dredging Discharge for the Construction of SWH at the Proposed Little Sioux Project Site

5.3.2.5.1 Nutrient Analyses of Collected Sediment/Soil Samples and Conducted Elutriate Testing

Table 18 summaries the nutrient analyses of sediment/soil samples collected at the proposed Little Sioux project site, and elutriate samples prepared from the collected sediment/soil samples. Pre-elutriate samples characterize total nutrients (i.e. settable, suspended, and dissolved nutrients) in the prepared elutriate mixture with minimal settling. Non-filtered elutriate samples characterize suspended nutrients remaining in the elutriate mixture supernatant after 1-hour of settling. Filtered elutriate samples characterize dissolved nutrients in the elutriate mixture supernatant. Pre-elutriate samples represent potential "end-of-pipe" nutrient concentrations of the slurry discharge prior to any mixing with the receiving water (i.e. Missouri River). Pre- elutriate samples were estimated, as describe in Section 4.4, for Total Kjeldahl Nitrogen, Ammonia, Nitrate/Nitrite, Total Nitrogen, and Total Phosphorus. Non-filtered elutriate samples were analyzed for Total Kjeldahl Nitrogen, Total Ammonia Nitrogen, and Total Phosphorus. Standard, filtered elutriate samples were analyzed for dissolved Nitrate/Nitrite Nitrogen and dissolved Phosphorus.

Table 18. Summary of nutrient analyses of sediment/soil samples collected at the proposed Little Sioux project site and elutriate testing of the collected sediment/soil samples.

	Total Kjeldahl N (mg/L)	Ammonia N (mg/L)	Nitrate/Nitrite N (mg/L)	Total P (mg/L)	Dissolved P (mg/L)
Site LS-S1:					
Sediment/Soil	580*	73*	4.8*	383*	-----
Pre-Elutriate					
Non-Filtered Elutriate	1.4	0.09	-----	0.30	-----
Standard Elutriate	-----	-----	2.10	-----	0.14
Site LS-S2:					
Sediment/Soil	383*	54*	2.8*	506*	-----
Pre-Elutriate					
Non-Filtered Elutriate	1.4	0.68	-----	0.16	-----
Standard Elutriate	-----	-----	1.10	-----	0.10
Site LS-S3:					
Sediment/Soil	293*	18*	2.8*	419*	-----
Pre-Elutriate					
Non-Filtered Elutriate	1.5	0.09	-----	0.27	-----
Standard Elutriate	-----	-----	1.70	-----	0.14
Mean Concentration					
Sediment/Soil	**419***	**48.3***	**3.5***	**436***	**-----**
Pre-Elutriate	**7.0**	**0.81**	**-----**	**7.31**	**-----**
Non-Filtered Elutriate	**1.4**	**0.29**	**-----**	**0.24**	**-----**
Standard Elutriate	**-----**	**-----**	**1.63**	**-----**	**0.13**

* mg/kg

5.3.2.5.2 Calculated Nutrient Fluxes and Loadings from Potential 20-Inch Hydraulic Dredge Discharge of Excavated Sediment/Soil

Potential nutrient fluxes from hydraulic dredging to excavate SWH at the proposed Little Sioux project site were calculated. The calculated nutrient fluxes were based on use of a typical 20-inch hydraulic dredge (i.e. 43.6 cfs discharge), and mean nutrient levels determined from the three sediment/soil samples collected from the proposed project site. As appropriate, nutrient fluxes for total (pre-elutriate), suspended (non-filtered elutriate), and dissolved (filtered elutriate) nutrients were estimated from elutriate testing results. Table 19 shows the calculated nutrient fluxes for Total Kjeldahl Nitrogen, Ammonia, Nitrate-Nitrite Nitrogen, Total Phosphorus, and Dissolved Phosphorus. Table 20 shows the estimated loadings (tons/day) based on the calculated nutrient fluxes. Table 21 compares the nutrient loadings calculated for the 20-inch hydraulic dredge discharge to the loadings estimated for the Missouri River on 9-May-2012 and long-term mean conditions.

Table 19. Nutrient flux rates calculated for a typical 20-inch hydraulic dredge discharge (43.6 cfs) based on mean sediment/soil nutrient levels sampled at the proposed Little Sioux project site.

Total Kjeldahl Nitrogen (kg/sec)		Ammonia (kg/sec)	Nitrate-Nitrite Nitrogen (kg/sec)	Total Phosphorus (kg/sec)		Dissolved Phosphorus (kg/sec)
Pre-Elutriate	Non-Filtered Elutriate	Non-Filtered Elutriate	Filtered Elutriate	Pre-Elutriate	Non-Filtered Elutriate	Filtered Elutriate
0.0086	0.0017	0.0004	0.0020	0.0090	0.0003	0.0002

Table 20. Daily nutrient loadings estimated for a typical 20-inch hydraulic dredge discharge (43.6 cfs) operating 12 hours a day based on nutrient fluxes calculated for mean sediment/soil nutrient levels sampled at the proposed Little Sioux project site.

Total Kjeldahl Nitrogen (tons/day)		Ammonia (tons/day)	Nitrate-Nitrite Nitrogen (tons/day)	Total Phosphorus (tons/day)		Dissolved Phosphorus (tons/day)
Pre-Elutriate	Non-Filtered Elutriate	Non-Filtered Elutriate	Filtered Elutriate	Pre-Elutriate	Non-Filtered Elutriate	Filtered Elutriate
0.41	0.08	0.02	0.10	0.43	0.02	0.01

Table 21. Comparison of daily nutrient loadings for the estimated dredging discharge from the proposed Little Sioux shallow-water habitat construction project and the Missouri River when monitored on 9-May-2012 and long-term mean conditions.

Total Kjeldahl Nitrogen (tons/day)		Ammonia (tons/day)	Nitrate-Nitrite Nitrogen (tons/day)	Total Phosphorus (tons/day)		Dissolved Phosphorus (tons/day)
Pre-Elutriate	Non-Filtered Elutriate	Non-Filtered Elutriate	Filtered Elutriate	Pre-Elutriate	Non-Filtered Elutriate	Filtered Elutriate
20-inch Hydraulic Dredge Discharge (43.6 cfs)						
0.41	0.08	0.02	0.10	0.43	0.02	0.01
Missouri River on 9-May-2012 (34,800 cfs)						
180.09		8.00	120.06	27.01		10.01
Missouri River mean conditions (31,719 cfs)						
85.54		7.70	97.52	17.96		5.99
Percent of Estimated 20-in Hydraulic Dredge Discharge Load of Missouri River Load on 9-May-2012						
0.2%	<0.1%	0.3%	0.1%	1.6%	0.1%	0.1%
Percent of Estimated 20-in Hydraulic Dredge Discharge Load of the Long-term Mean Missouri River Load						
0.5%	0.1%	0.3%	0.1%	2.4%	0.1%	0.2%

Note: Dredge flow (43.6 cfs) to mean Missouri River flow (31,719 cfs) is 0.14% (i.e. a dredging discharge of 43.6 cfs would represent 0.14% of the mean Missouri River flow of 31,719 cfs).

5.3.2.6 Comparison of Estimated Nutrient Loadings from Hydraulic Dredging at the Proposed Little Sioux Project to Ambient Nutrient Loadings in the Missouri River

The Omaha District monitors water quality conditions in the Missouri River from near Landusky, MT (RM1922) to Rulo, NE (RM498). This includes seven locations monitored monthly since 2003 from the Gavins Point Dam tailwaters (RM810) to Rulo, NE. Nutrient constituents monitored monthly include Total Kjeldahl Nitrogen, Ammonia, Nitrate/Nitrite, Total Nitrogen, Total Phosphorus, and Dissolved Phosphorus. Figure 8 displays the mean daily loads for calculated for Total Nitrogen, Nitrate/Nitrite N, and Total Phosphorus for the seven monitored locations on the Missouri River downstream of Gavins Point Dam over the 5-year period 2007 through 2011. Figure 8 also shows the location of the proposed Little Sioux project site. Figure 9 compares the estimated daily dredging discharge loading for Total Nitrogen, Nitrate/Nitrite N, and Total Phosphorus and the calculated mean daily loads for the Missouri River immediately upstream (i.e. RM691) and downstream (i.e. RM619) of the proposed Little Sioux project site. Total nitrogen was determined by adding Total Kjeldahl Nitrogen and Nitrate/Nitrite Nitrogen. As indicated in Table 21 and Figure 9, the estimated daily nutrient loading from the proposed Little Sioux project site is minor compared to the ambient nutrient loading currently present in the Missouri River. The greatest nutrient loading from the proposed dredging would be for Total Phosphorus where the dredging discharge daily loading could result in a 2.4% increase in the mean daily suspended Total Phosphorus loading currently present in the Missouri River. It is noted that much of the discharged

particulate material, and associated phosphorus, would settle to the bottom of the Missouri River when discharged and be incorporated in the river's bed-load. The difference between a pre-elutriate sample and a non-filtered sample for Total Phosphorus is 1-hour of settling time. The elutriate testing of the collected Little Sioux sediment samples resulted in mean pre-elutriate and non-filtered elutriate Total Phosphorus concentrations of 7.31 mg/L and 0.24 mg/L, respectively. Accounting for 1-hour settling, the 2.4% increase in mean daily suspended Total Phosphorus loading falls to 0.1% of the suspended Missouri River loading.

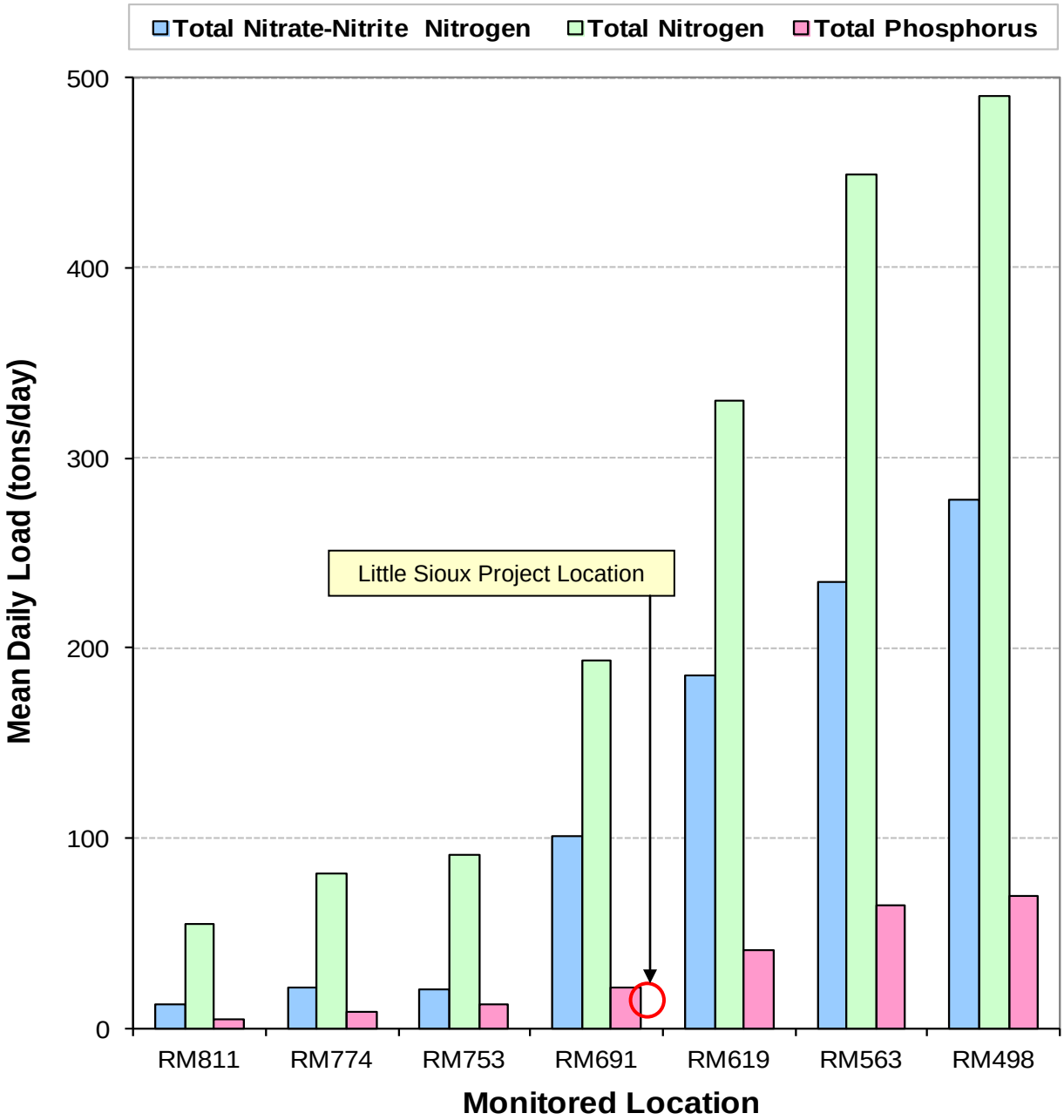

Figure 8. Mean daily loads for Total Nitrogen, Nitrate/Nitrite Nitrogen, and Total Phosphorus based on monthly monitoring along the Missouri River from Gavins Point Dam to Rulo, Nebraska over the 5-year period 2007 through 2011.

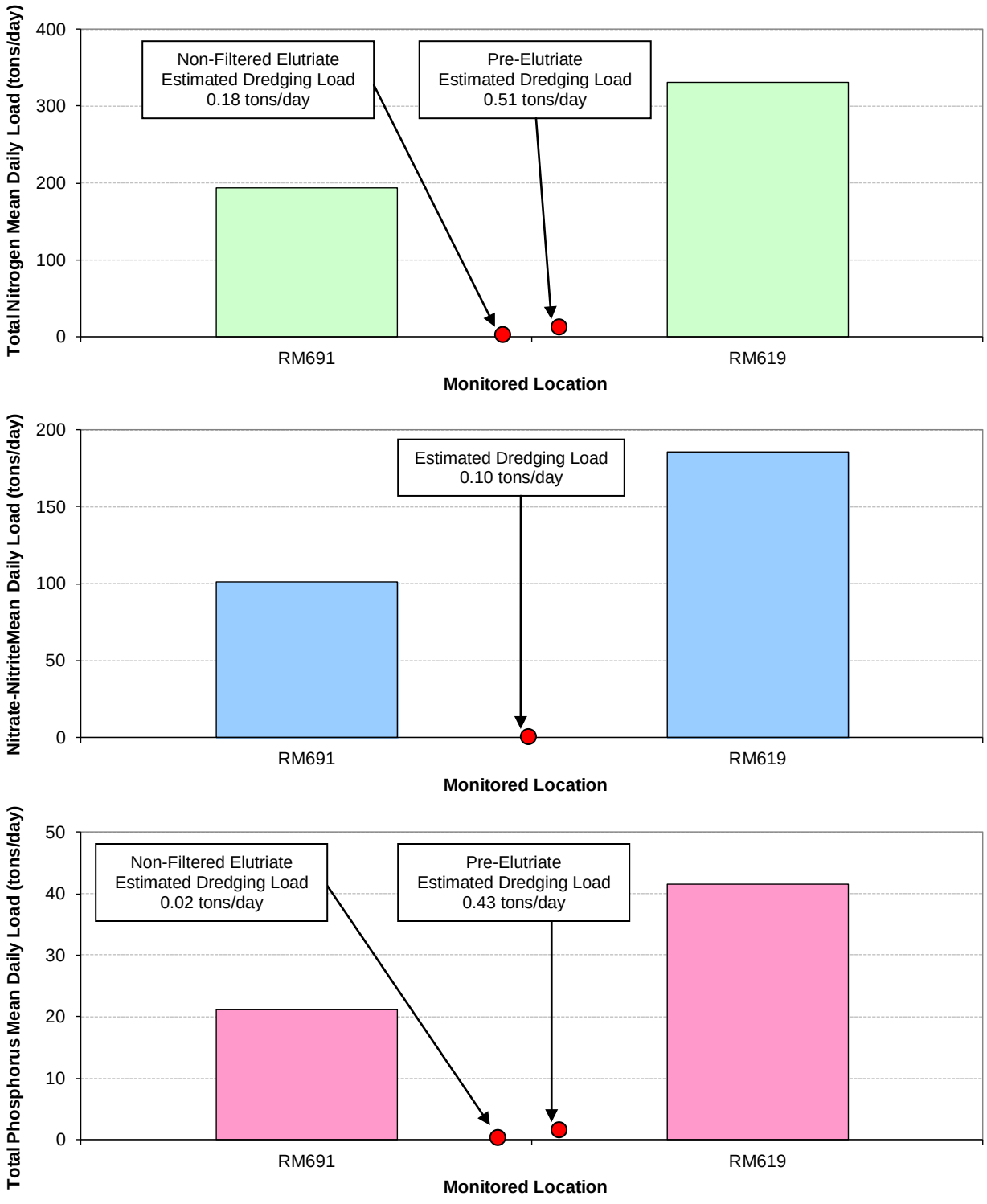

Figure 9. Comparison of estimated Total Nitrogen, Nitrate/Nitrite Nitrogen, and Total Phosphorus daily loadings from hydraulic dredging discharge to construct proposed shallow-water habitat at the Little Sioux project site to mean daily loadings calculated for the Missouri River at RM 691 and RM619 over the 5-year period 2007 though 2011.

5.4 Proposed Disposal Site Determinations

Mixing zone provisions for water quality standards application typically apply to "toxic contaminants" released from a point source discharge. State water quality standards, in most cases, define acute and chronic numeric criteria for toxic contaminants. Mixing zones are meant to provide water quality protection to a waterbody receiving a point source discharge, while at the same time allowing the discharge to initially mix and disperse within the receiving waterbody. Generally, mixing zones are to allow for a zone of passage for aquatic life and ensure that acute water quality standards criteria are not exceeded unless an allowance is made for a small zone of initial dilution. Chronic water quality standards criteria are typically allowed to be exceeded within the defined boundary of the mixing zone.

The Section 404(b)(1) Guidelines, at §230.11(f), allow for mixing zones. Mixing zones for dredge and fill discharges are to be confined to the smallest practicable zone that is consistent with the type of dispersion determined to be appropriate. The following factors are identified in §230.11(f) for consideration in determining the acceptability of a proposed mixing zone:

- Depth of water at the disposal site;
- Current velocity, direction, and variability at the disposal site;
- Degree of turbulence;
- Stratification attributable to causes such as obstructions, salinity or density profiles at the disposal site;
- Rate of discharge;
- Ambient concentration of constituents of interest;
- Dredged material characteristics, particularly concentrations of constituents, amount of material, type of material (sand, silt, clay, etc.) and settling velocities;
- Number of discharge actions per unit of time; and
- Other factors of the disposal site that affect the rates and patterns of mixing.

Elutriate testing of the collected sediment/soil samples at the proposed Little Sioux project site indicated that all assessed constituents met applicable acute and chronic numeric water quality standards. As such, numeric water quality standards will be met in the dredge slurry at the "end-of-pipe" discharge. Since a "regulated" mixing is not needed to ensure compliance with numeric water quality standards, it's assumed complete mixing of the dredging discharge with the flow in the Missouri River is appropriate in evaluating potential impacts to existing water quality pursuant to State and Federal antidegradation provisions.

5.4.1 Completely Mixed Conditions

Impacts of the proposed dredging discharge on existing water quality in the Missouri River was evaluated after consideration was given for complete mixing of the dredging discharge with the flow in the Missouri River. This was accomplished by calculating a flow-weighted average concentration for a water quality constituent based on flow and constituent concentration in the Missouri River and dredging discharge. The average mean daily flow of the Missouri River was determined at Decatur, NE (RM691) based on the period of record (1988 - 2012) mean daily flows recorded at the USGS's Decatur gauge (06601200). The average mean daily flow of the Missouri River at Decatur, NE was determined to be 31,719 cfs (range = 7,070 - 189,000 cfs; median = 28,500 cfs).

5.4.2 Existing Missouri River Water Quality

Since 2003, the Omaha District has monitored water quality conditions monthly at seven locations along the Missouri River from the Gavins Point Dam tailwaters to Rulo, Nebraska. Constituents monitored monthly include Chemical Oxygen Demand, Total Organic Carbon, Total Kjeldahl Nitrogen, Ammonia, Nitrate-Nitrite, Total Nitrogen, Total Phosphorus, and Dissolved Phosphorus. The elutriate testing results of the sediment/soil collected at the proposed Little Sioux project site were compared

(plotted) to the ambient water quality conditions monitored in the Missouri River at Decatur, NE over the 5-year period 2007 through 2011 (Figures 10 - 17). Calculation of completely mixed conditions was applied to the estimated pre-elutriate results for Ammonia, Total Kjeldahl Nitrogen, and Total Phosphorus; and monitored Missouri River water quality conditions over the 5-year period (2007 - 2011). Table 22 summarizes the calculation of completely mixed conditions for Ammonia, Total Kjeldahl Nitrogen, and Total Phosphorus.

Table 22. Completely mixed, flow-weighted conditions for estimated pre-elutriate concentrations of Ammonia, Total Kjeldahl Nitrogen, and Total Phosphorus.

Water Quality Constituent	Missouri River		Dredging Discharge		Completely Mixed Concentration
	Average Flow (cfs)	Average Concentration	Design Flow (cfs)	Average Pre-Elutriate Concentration	
Nitrogen, Ammonia as N (mg/L)	31,719	0.09	43.6	0.81	0.091
Nitrogen, Kjeldahl Total as N (mg/L)	31,719	1.0	43.6	7.0	1.01
Phosphorus, Total (mg/L)	31,719	0.21	43.6	7.31	0.220

5.5 Summary of Water Quality Factual Determinations

- Elutriate testing of representative sediment/soil samples collected at the proposed Little Sioux project site indicates that no numeric water quality standards criteria will likely be violated by the proposed dredging discharge. This is based on comparison of elutriate testing results to promulgated Iowa and Nebraska numeric water quality criteria. Elutriate testing results were for both dissolved and non-filtered elutriate sample analyses prepared in accordance with the *"Inland Testing Manual"*.
- The proposed dredging discharge should have minor impacts to the existing water quality of the Missouri River, especially after complete mixing is achieved in the river. Based on analyzed water quality constituents, only minor increases in constituent concentrations, within the natural variability of water quality in the Missouri River, are indicated. The minor impacts to water quality would only occur during the short-time dredging occurred to construct SWH at the proposed Little Sioux project site.
- The dredging discharge to construct SWH at the proposed Little Sioux project site could cause a slight increase to the nutrient loading currently present in the Missouri River. It is estimated that the mean daily suspended load for Total Nitrogen could be increased by 0.2%, and the mean daily suspended load for Total Phosphorus could be increased by up to 2.4%. It is noted that the 2.4% increase in the suspended Total Phosphorus loadings is a worst-case estimate. Most of the suspended Total Phosphorus load is bound to particulate matter that will settle and become incorporated into the bed-load of the Missouri River. The bed-load Total Phosphorus loading is in addition to the suspended Total Phosphorus loading estimated in this report. As indicated by elutriate testing results, the estimated mean suspended Total Phosphorus concentration of 7.31 mg/L (estimated pre-elutriate) could decrease to 0.24 mg/L (non-filtered elutriate) after 1-hour of settling time.

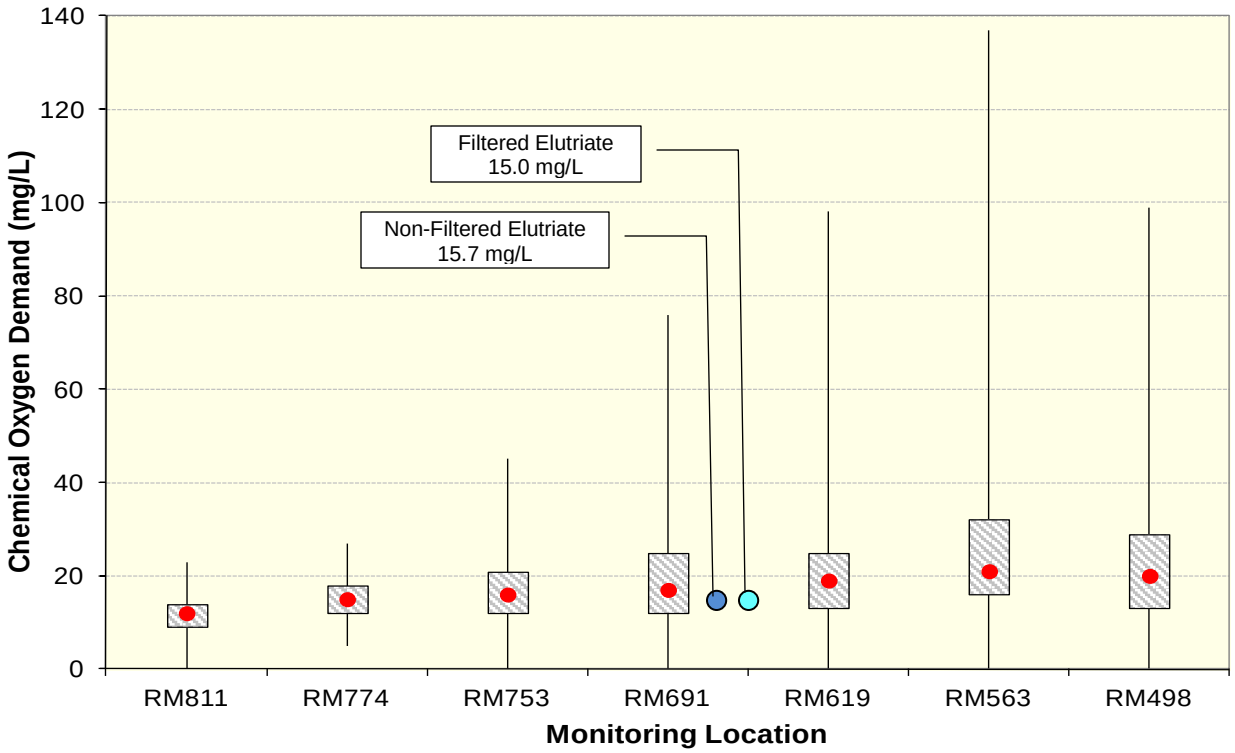

Figure 10. Mean elutriate testing results for Chemical Oxygen Demand as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011. Box plot displays minimum and maximum (whiskers) and inter-quartile range, red dot is the median value.

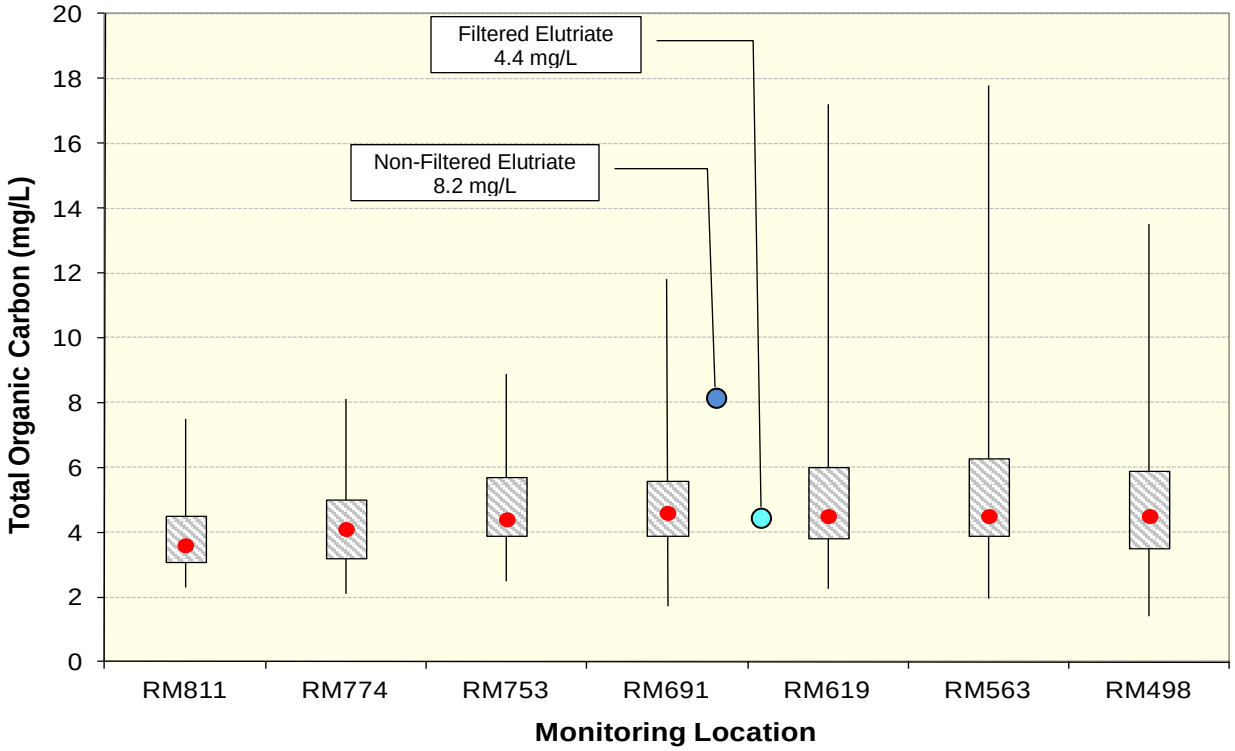

Figure 11. Mean elutriate testing results for Total Organic Carbon as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011.

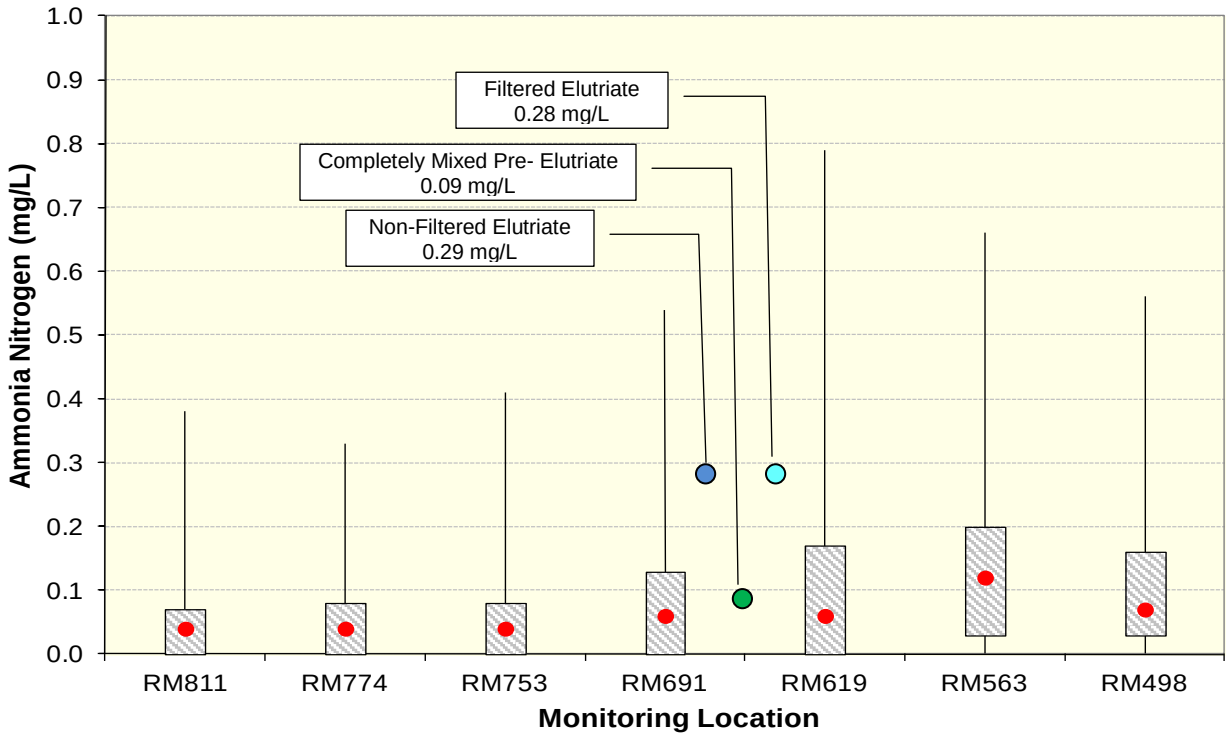

Figure 12. Mean elutriate testing results for Ammonia as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011.

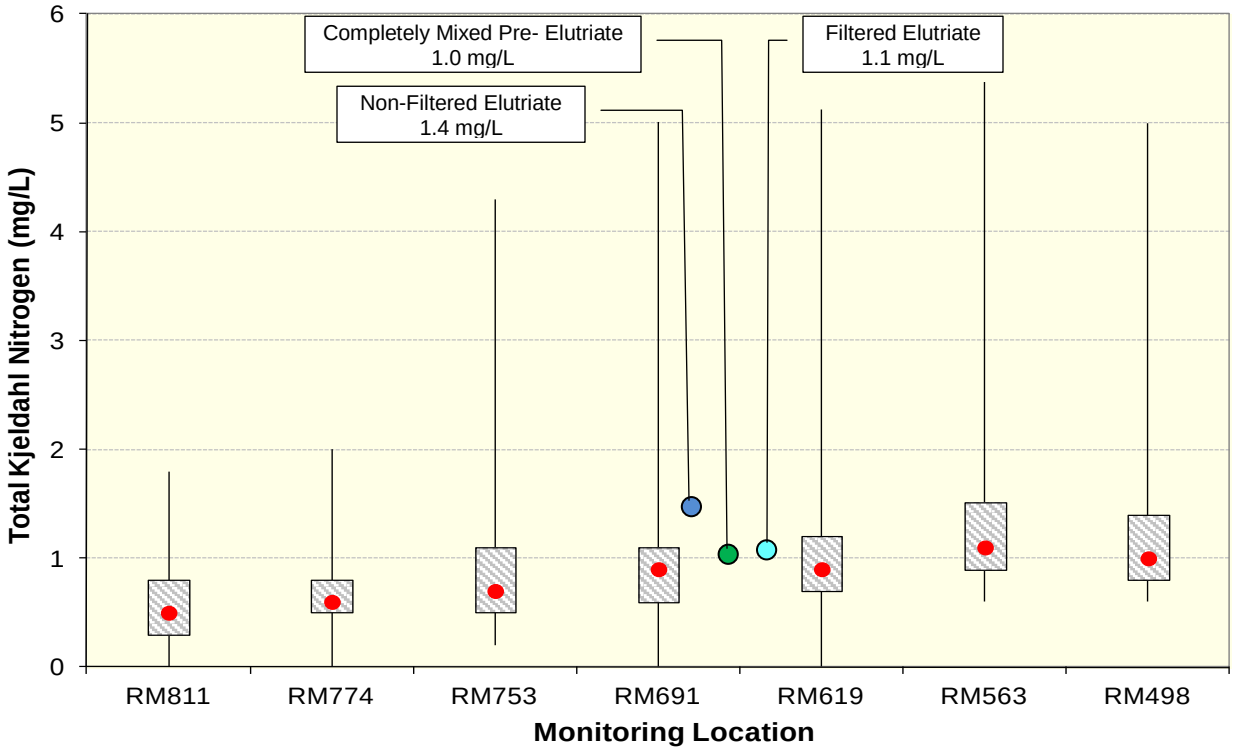

Figure 13. Mean elutriate testing results for Total Kjeldahl Nitrogen as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011.

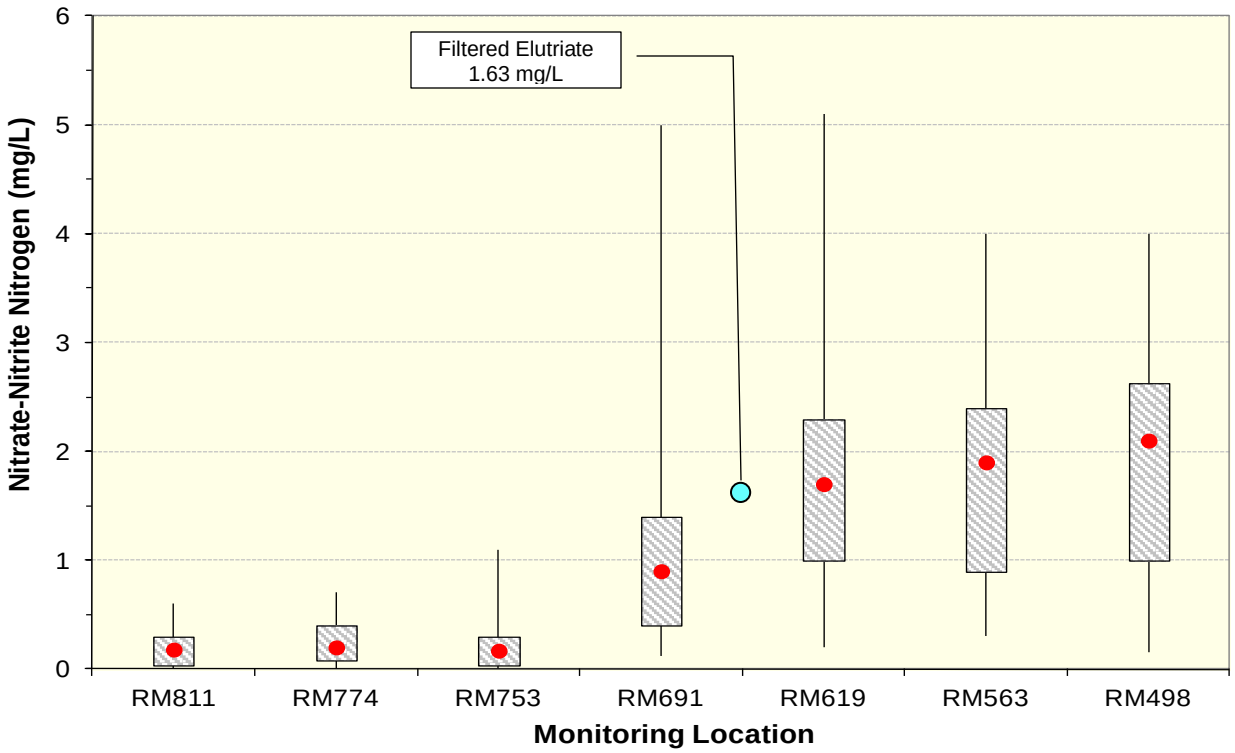

Figure 14. Mean elutriate testing results for Nitrate-Nitrite Nitrogen as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011.

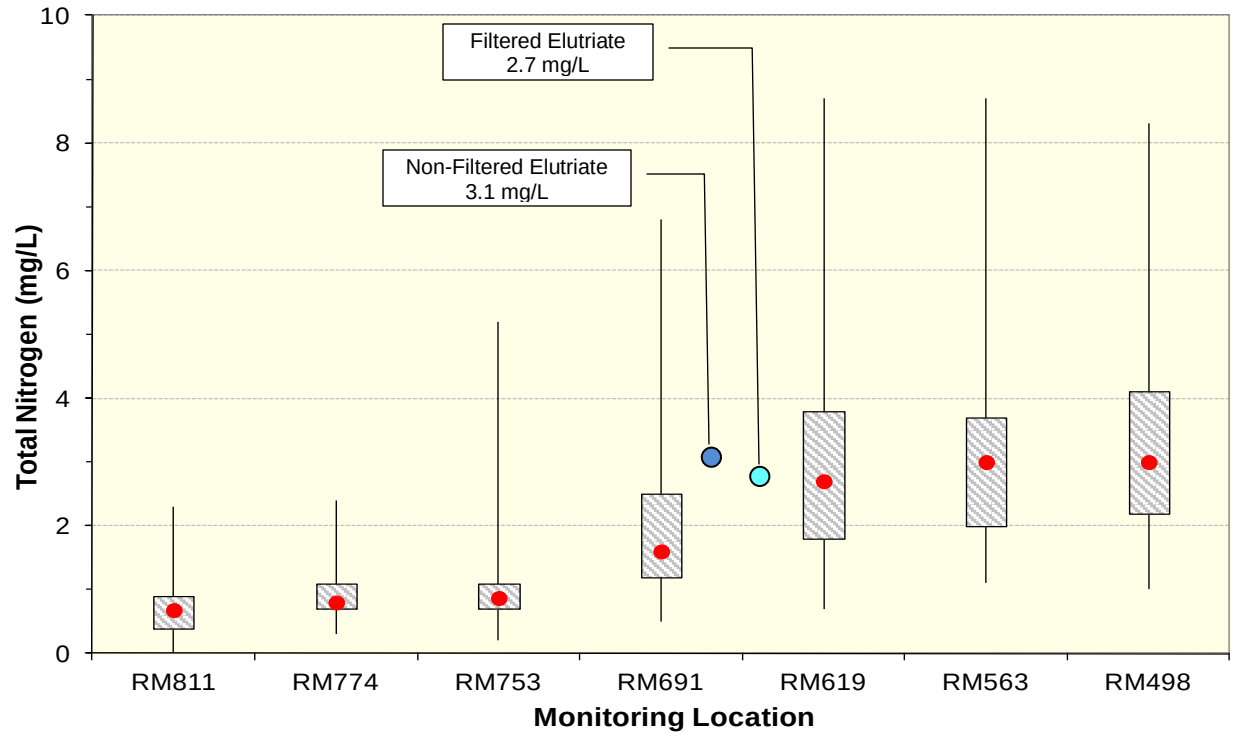

Figure 15. Mean elutriate testing results for Total Nitrogen as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011.

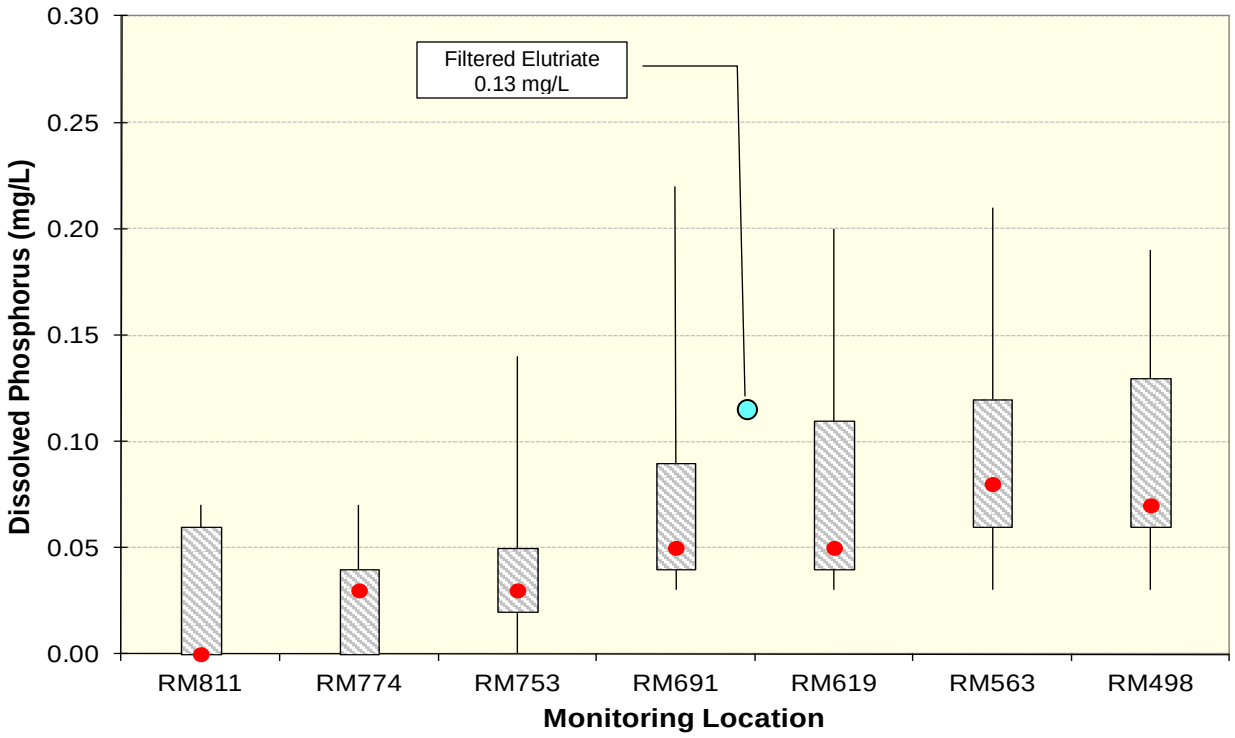

Figure 16. Mean elutriate testing results for Dissolved Phosphorus as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011.

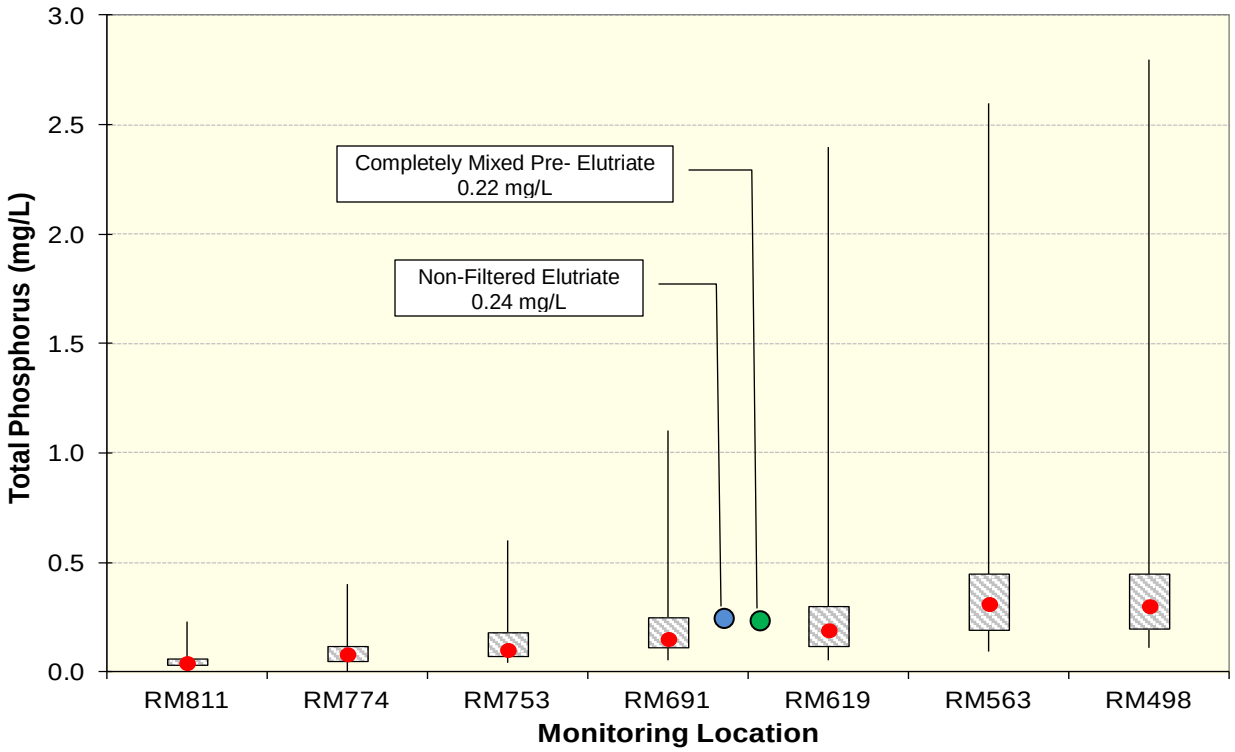

Figure 17. Mean elutriate testing results for Total Phosphorus as compared to ambient Missouri River conditions monitored over the 5-year period 2007 through 2011.

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ATTACHMENT 1

Sampling and Analysis Plan for 2012 Elutriate Sampling – Missouri River Little Sioux Project Area.

SAMPLING AND ANALYSIS PLAN

for

2012 Elutriate Sampling – Missouri River
Little Sioux Bend Project Area

Project Number: SPS-LSXBND-001

Prepared By:

Water Control and Water Quality Section
Hydrologic Engineering Branch
U.S. Army Corps of Engineers – Omaha District

April 2012

/ Dave Jensen for Bill Otto
USACE – Water Quality Unit Sampling Coordinator — 4-May-2012 Date

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Kellie Bergman
USACE – Chief, Water Control and Water Quality Section — 4 May 2012 Date

David Rickel
USACE – Chief, Sedimentation & Channel Stabilization Section — 4 May 2012 Date

Luke Wallace
USACE – (CENWO-PM-AE) — 4 May 2012 Date

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Luke Wallace

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1. PROJECT DESCRIPTION

1.1. BACKGROUND INFORMATION

A project is being proposed to create shallow-water habitat along the Missouri River in Harrison County, Iowa and Burt County, Nebraska. The project area is actually on the Nebraska side of Missouri River and will basically run down the old river channel that is the legal boundary between the States of Iowa and Nebraska. The District is referring to this proposed project as the Little Sioux Bend Project. Soil will be excavated from an old chute area to create shallow-water habitat. Construction of the shallow-water habitat will involve dredging with the dredge spoil being discharged to the Missouri River. It is believed the dredge material will be primarily sand with some silts and clays.

1.1.1. Project Location

The project area is located in Harrison County, Iowa and Burt County, Nebraska along the Little Sioux Bend of the Missouri River between river miles (RM) 666 and 669 (Attachment 1).

1.1.2. 404 Permitting Requirements

The requirements for a USACE Individual Section 404 permit must be met for the proposed dredging activity. To meet the Section 404 Individual Permit requirements, a Section 401 Certification must be obtained from the States of Nebraska and Iowa that "certifies" the proposed actions will not "violate" State water quality standards. To facilitate review of the proposed project for Section 401 Certification, "elutriate sampling" of material from the proposed dredging site will be conducted. This monitoring project plan was developed to collect the appropriate materials for elutriate analysis pursuant to the Inland Testing Manual, "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (USEPA and USACE, 1998).

2. PROJECT/TASK ORGANIZATION AND RESPONSIBILITIES

The USACE's Water Control and Water Quality Section will conduct the sampling required to facilitate elutriate analysis of prospective dredge material in the project area.

Staff Responsibilities and Contacts for Sampling:
Sample Collection: Dave Jensen (995-2310), Bill Otto (995-2313), John Hargrave (995-2347)
Sampling Coordination: Dave Jensen
Data Quality Review: Dave Jensen
Laboratory Analysis: Midwest Laboratories, Prem Arora (829-9878)

3. SITE-SPECIFIC WATER QUALITY CONCERNS

The State of Nebraska has issued a fish consumption advisory for Dieldrin and PCBs on the Missouri River downstream of Gavins Point Dam. This is based on the analysis of fish tissue samples that found levels of these substances at concentrations above the State's defined risk factor for protecting public health via fish consumption.

Nebraska's water quality standards identify the Missouri River from the Big Sioux River to the Platte River as designated Segment MT1-10000. Section 303(d) of the Federal Clean Water Act requires States to evaluate water quality conditions in designated waterbodies, and list as impaired (i.e., 303d list) any waterbodies not meeting water quality standards. As appropriate, States must develop and implement Total Maximum Daily Loads –TMDLs (i.e., pollutant management plans) for waterbodies identified as impaired. Segment MT1-10000 is listed on Nebraska's 2010 Section 303(d) list as impaired due a fish consumption advisory. The identified parameters of concern are Cancer Risk & Hazard Index Compounds. The Cancer Risk & Hazard Compounds specifically relate to the fish consumption advisory for Dieldrin and PCBs. The State of Nebraska has stated that due to the 303(d) listing of Segment MT1-10000 no dredged material can be discharged into the Missouri River unless concerns regarding Dieldrin and PCBs are addressed.

Nebraska has promulgated surface water quality criteria for Dieldrin and PCBs of 0.00144 ug/l and 0.0017 ug/l (i.e., 1.4 and 1.7 parts-per-trillion), respectively. These values are defined as human health criteria at the 10^{-5} risk level for carcinogens based on the consumption of fish and other aquatic organisms. If levels of Dieldrin and PCBs determined from elutriate analysis of prospective dredge materials are found to be below the state water quality criteria this should meet potential concerns of the State regarding Dieldrin and PCBs in the discharge of dredged material.

4. DATA QUALITY OBJECTIVES

The data collected through this monitoring project is meant to facilitate the review of the proposed dredging project by the States of Iowa and Nebraska for Section 401 Water Quality Certification.

5. DATA COLLECTION APPROACH

5.1. DATA COLLECTION DESIGN

5.1.1. Soil and Receiving Water Samples

Soil samples will be collected at three sites (LS-S1, LS-S2, and LS-S3) and receiving water (Missouri River) at one site (LS-W1). The location of the four sites within the project area is shown in Attachments 1 and 2. Preliminary latitude and longitude coordinates for the four sites are given below. The "actual" location of the sampled sites will be determined with a GPS unit in the field when the samples are collected.

Site	Latitude	Longitude
LS-S1	41° 47' 19.8"	96° 03' 56.0"
LS-S2	41° 47' 04.4"	96° 04' 04.2"
LS-S3	41° 46' 41.4"	96° 04' 24.3"
LS-W1	41° 47' 24.6"	96° 03' 52.1"

5.2. MEASUREMENT AND SAMPLING METHODS

5.2.1. Receiving Water Sample

Water from the dredge site (i.e., receiving water) will be used to prepare elutriate samples (see Section 2.2.3). The laboratory requires 4 parts receiving water for each 1 part of soil/sediment to be analyzed. In addition to the 4 parts of water for each 1 part soil/sediment, additional receiving water is required for analysis. The receiving water will be collected at Site LB-W1 near the boat ramp.

At the time the receiving water is collected, the following field measurements will be taken: dissolved oxygen, pH, water temperature, conductivity, and turbidity. These measurements will be obtained with a "HydroLab" equipped with a MS5 DataSonde and Surveyor data logger. Measurements will be taken by immersion of the DataSonde directly into the river. Measurements will be appropriately recorded on a field sheet (Attachment 3).

5.2.2. Soil Samples

Soil samples will be collected at Sites LS-S1, LS-S2, and LS-S3. The equipment, supplies, and procedures to be used to collect the soil samples are as follows.

5.2.2.1. Equipment and Supplies

1) Gas powered auger head
2) Stainless steel coring device
3) Gasoline
4) 1 gallon wide mouth glass jars
5) 1 gallon narrow mouth glass jugs
6) Sample bottle labels
7) ARF
8) Field Sheets
9) GPS device
10) 5 gallon buckets
11) Several gallons of tap water
12) Pick/hammer
13) Tarp/cardboard
14) Screwdriver
15) Scrub brush
16) Cooler with Ice

5.2.2.2. Soil Collection Procedure

1) Select sample site and record general information (including Latitude/Longitude) on the field sheet.
2) Remove any vegetation near the proposed boring side (2-3 foot diameter circle).
3) Set out equipment on a tarp near the sample hole. Using a tarp keeps vegetation and other material out of the sample collection bucket.
4) If the ground is frozen, use a pick-type hammer to remove the top 3-6 inches of frozen soil.
5) Attach the corer to the auger head, bore down and collect sample in approximately one-foot increments.

6) After each coring, detach the device from the gas auger, suspend the corer over the sample collection bucket and deposit the sample into the collection bucket.
7) Heavy clays may require a screwdriver, hammer and/or wooden stake or other tool to remove the sample from the corer.
8) When all cores from one site have been collected in the bucket, homogenize the contents and transfer it to a wide mouth glass jar. Affix the sample label to the jar prior to filling it with the sample.
9) Clean the coring device, tools and sample collection bucket with tap water between sample locations.
10) Deliver the samples and an analytical request form to the laboratory analyzing the samples.

5.2.3. Preparation of Elutriate Samples

Elutriate testing will been done on soil samples collected at Sites LS-S1, LS-S2, and LS-S3. Standard elutriate samples will be prepared in accordance with the "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual: Inland Testing Manual" (USEPA and USACE, 1998). The elutriate sample will be prepared by using water from the dredging site. The sample will be prepared by subsampling approximately 1-liter of the collected soil sample from the well-mixed original sample. The soil material and unfiltered receiving water are then combined in a soil-to-water ratio of 1:4 on a volume basis at room temperature. After the correct ratio is achieved, the mixture is stirred vigorously for 30 minutes with a mechanical stirrer/shaker. After the 30 minute mixing period, the mixture is allowed to settle for at least one hour. The supernatant is then siphoned off without disturbing the settled material. As appropriate, a 0.45-micron filter is then used for dissolved inorganic constituents.

5.3. SAMPLE HANDLING, CUSTODY, AND TRANSPORT

The collected samples will be transported by sampling personnel to Midwest Laboratories, Inc. in Omaha, Nebraska for analysis. An Analytical Request Form (ARF) will be completed and submitted with the samples delivered to the laboratory (Attachment 4).

5.4. PARAMETERS TO BE MEASURED

The parameters that will be measured or analyzed for the different types of samples are listed in Table 1.

Table 1. Parameters to be measured and analyzed.

Parameter	Sample Analysis		
	Soil	Receiving Water	Elutriate Water
Field Measurements:			
Water Temperature (°C)		X	
pH (S.U)		X	
Dissolved Oxygen (mg/l)		X	
Conductivity (umhos/cm)		X	
Turbidity (NTU)		X	
Laboratory Analysis:			
Atrazine (ug/l)	X	X	X*
Carbonaceous Biochemical Oxygen Demand - CBOD (mg/l)		X	X*
Chemical Oxygen Demand - COD (mg/l)		X	X
Dieldrin (pptrillion)		X	X*
Nitrogen, Ammonia as N, Total (mg/l)	X	X	X*
Nitrogen, Total Kjeldahl as N (mg/l)	X	X	X*
Nitrogen, Nitrate/Nitrite as N (mg/l)	X	X	X
Organic Carbon, Total - TOC (mg/l)	X	X	X*
Particle Size	X		
PCBs - Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260 (pptrillion)		X	X*
pH (S.U.)	X	X	X
Phosphorus, Dissolved (mg/l)		X	X
Phosphorus, Total (mg/l)	X	X	X*
Phosphorus, Orthophosphate (mg/l)		X	X
Metals - Dissolved (ug/l) (Aresenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc)		X	X
Metals - Total (mg/kg) (Aresenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc)	X		
Organochlorine Pesticide and PCB Scan (ug/kg)	X		
Organochlorine Pesticide and PCB Scan (ug/l)		X	X*
Total Suspended Solids (mg/l)		X	X*
Turbidity (NTU)		X	X*

***** Determined on supernatant prior to filtration.

5.5. LABORATORY ANALYTICAL METHODS AND COSTS

Table 2 provides methods, detection limits, and costs for parameters to be analyzed on collected soil samples. Table 4 provides methods and detection limits for parameters to be analyzed on filtered elutriate samples. Table 5 provides methods and detection limits for parameters to be analyzed on supernatant elutriate samples. Table 7 provides methods and detection limits for parameters to be analyzed on receiving water.

Table. 2. Parameters to be Analyzed on Collected Soil Samples and Unit Costs.

Parameter	Method	Detection Limit	Analytical Cost
PHYSICAL AND AGGREGATE PROPERTIES			
Particle Size	Sieve (Minimum Sieve #200)	0.001 mm	$63.75
pH	EPA 150.1	0.1 S.U.*	7.30
NUTRIENTS			
Nitrogen, Ammonia Total as N	EPA 350.1	0.02 mg/kg	17.35
Nitrogen, Kjeldahl Total as N	EPA 351.3	0.2 mg/kg	20.15
Nitrogen, Nitrate/Nitrite Total as N	EPA 353.2	0.02 mg/kg	13.00
Phosphorus, Total	SM4500PF	0.02 mg/kg	18.40
AGGREGATE ORGANIC CONSTITUENTS			
Total Organic Carbon	EPA 415.1	0.4 mg/kg	26.00
METALS			
Arsenic, Total	EPA 6010B	10 mg/kg	12.50
Cadmium, Total	EPA 6010B	0.2 mg/kg	12.50
Chromium, Total	EPA 6010B	1 mg/kg	12.50
Copper, Total	EPA 6010B	1 mg/kg	12.50
Lead, Total	EPA 6010B	13 mg/kg	12.50
Mercury, Total	EPA 6010B	0.1 mg/kg	40.30
Nickel, Total	EPA 6010B	1 mg/kg	12.50
Zinc Total	EPA 6010B	2 mg/kg	12.50
PESTICIDES AND PCBs			
Atrazine, Total	EPA 507	0.05 mg/kg	101.00
Organochlorine Pesticide and PCB Scan	EPA 8081 and EPA 8082	See Table 3	165.00
Total Laboratory Cost for Analyzing a Soil Sample			**$559.75**

* Resolution limit.

Table 3. Detection and Reporting Limits for individual parameters included in the Organochlorine Pesticide and PCB Scan of sediment samples.

Parameter	Detection Limit (µg/kg)	Reporting Limit (µg/kg)	Parameter	Detection Limit (µg/kg)	Reporting Limit (µg/kg)
DDE	0.8	9.9	Alpha-BHC (alpha-Lindane)	0.4	5.1
DDD	0.7	9.9	Beta-BHC (beta-Lindane)	1.0	5.1
DDT	1.0	9.9	Delta-BHC (delta-Lindane)	1.8	5.1
Methoxychlor	1.2	5.1	Gamma-BHC (gamma-Lindane)	0.6	5.1
Aldrin	0.7	5.1	Gamma-Chlordane	0.8	5.1
Dieldrin	0.7	9.9	PCB - Aroclor1016	10	50
Endosulfan 1	0.7	5.1	PCB - Aroclor1260	10	50
Endosulfan 2	0.8	9.9	PCB - Aroclor1221	10	50
Endosulfan Sulfate	1.0	9.9	PCB - Aroclor1248	10	50
Endrin	1.0	9.9	PCB - Aroclor1268	10	50
Endrin Aldehyde	1.0	9.9	PCB - Aroclor1232	10	50
Endrin Ketone	0.8	9.9	PCB - Aroclor1254	10	50
Heptachlor	0.6	5.1	PCB - Aroclor1242	10	50
Heptachlor Epoxide	0.8	5.1	PCB - Aroclor1262	10	50
Alpha-Chlordane	0.8	5.1			

Table. 4. Parameters to be Analyzed in Filtered Elutriate Water Samples and Unit Costs.

Parameter	Method	Detection Limit	Analytical Cost
SAMPLE PREPARATION			
Elutriate Sample Preparation	1:4 Sediment:Receiving Water	-----	$175.00
PHYSICAL AND AGGREGATE PROPERTIES			
pH	EPA 150.1	0.1 S.U.*	7.30
NUTRIENTS			
Nitrogen, Nitrate/Nitrite as N (mg/l)	EPA 353.2	0.02 mg/l	13.00
Phosphorus, Dissolved	SM4500PF	0.02 mg/l	18.40
Ortho-Phosphorus, Dissolved	EPA 365.1	0.02 mg/l	14.00
AGGREGATE ORGANIC CONSTITUENTS			
Chemical Oxygen Demand	ASTM D1252	3 mg/l	17.85
METALS			
Arsenic, Dissolved	EPA 6010B	1 ug/l	12.50
Cadmium, Dissolved	EPA 6010B	0.2 ug/l	12.50
Chromium, Dissolved	EPA 6010B	10 ug/l	12.50
Copper, Dissolved	EPA 6010B	2 ug/l	12.50
Lead, Dissolved	EPA 6010B	0.5 ug/l	12.50
Mercury, Dissolved	EPA 6010B	0.05 ug/l	40.30
Nickel, Dissolved	EPA 6010B	10 ug/l	12.50
Zinc Dissolved	EPA 6010B	10 ug/l	12.50
Total Laboratory Cost for Analyzing a Standard Elutriate Water Sample			**$373.35**

* Resolution limit.

Table. 5. Parameters to be Analyzed in Supernatant Elutriate Water Samples and Unit Costs.

Parameter*	Method	Detection Limit	Analytical Cost
PHYSICAL AND AGGREGATE PROPERTIES			
Total Suspended Solids	EPA 160.1	5 mg/l	$10.70
Turbidity	EPA 180.1	1 NTU	13.25
NUTRIENTS			
Nitrogen, Ammonia as N, Total	EPA 350.1	0.02 mg/l	17.35
Nitrogen, Total Kjeldahl as N	EPA 351.3	0.2 mg/l	20.15
Phosphorus, Total	SM4500PF	0.02 mg/l	18.40
AGGREGATE ORGANIC CONSTITUENTS			
Carbon, Organic Total	EPA 415.1	0.4 mg/l	26.00
Carbonaceous Biochemical Oxygen Demand - CBOD	SM 5210.B	1 mg/l	28.55
Atrazine (ug/l)	EPA 507	0.05 ug/l	156.00
Dieldrin (ug/l)	EPA - 8081	0.001	624.00
PCBs - Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260 (ug/l)	EPA - 8082	0.001	624.00
Organochlorine Pesticide and PCB Scan (ug/l)	EPA 8081 EPA 8082	See Table 6	165.00
Total Laboratory Cost for Analyzing a Pre-Elutriate Water Sample			**$1,703.40**

Table 6. Detection and Reporting Limits for individual parameters included in the Organochlorine Pesticide and PCB Scan of water samples.

Parameter	Detection Limit (µg/l)	Reporting Limit (µg/l)	Parameter	Detection Limit (µg/l)	Reporting Limit (µg/l)
DDE	0.005	0.1	Alpha-BHC (alpha-Lindane)	0.009	0.05
DDD	0.005	0.1	Beta-BHC (beta-Lindane)	0.009	0.05
DDT	0.004	0.1	Delta-BHC (delta-Lindane)	0.014	0.05
Methoxychlor	0.005	0.5	Gamma-BHC (gamma-Lindane)	0.035	0.05
Aldrin	0.008	0.5	Gamma-Chlordane	0.006	0.05
Dieldrin	0.004	0.1	PCB - Aroclor1016	0.2	1.0
Endosulfan 1	0.006	0.05	PCB - Aroclor1260	0.2	1.0
Endosulfan 2	0.003	0.1	PCB - Aroclor1221	0.2	2.0
Endosulfan Sulfate	0.010	0.1	PCB - Aroclor1248	0.3	1.0
Endrin	0.003	0.1	PCB - Aroclor1268	0.3	1.0
Endrin Aldehyde	0.011	0.1	PCB - Aroclor1232	0.2	1.0
Endrin Ketone	0.006	0.1	PCB - Aroclor1254	0.2	1.0
Heptachlor	0.009	0.05	PCB - Aroclor1242	0.2	1.0
Heptachlor Epoxide	0.007	0.05	PCB - Aroclor1262	0.2	1.0
Alpha-Chlordane	0.011	0.05			

Table. 7. Parameters to be Analyzed in Receiving Water Sample and Unit Costs.

Parameter	Method	Detection Limit	Analytical Cost
PHYSICAL AND AGGREGATE PROPERTIES			
Total Suspended Solids	EPA 160.2	4 mg/l	10.70
NUTRIENTS			
Nitrogen, Ammonia as N, Total (mg/l)	EPA 350.1	0.02 mg/l	17.35
Nitrogen, Total Kjeldahl as N (mg/l)	EPA 351.3	0.2 mg/l	20.15
Nitrogen, Nitrate/Nitrite as N (mg/l)	EPA 353.2	0.02 mg/l	13.00
Phosphorus, Dissolved	SM4500PF	0.02 mg/l	18.40
Phosphorus, Total	SM4500PF	0.02 mg/l	18.40
Ortho-Phosphorus, Dissolved	EPA 365.1	0.02 mg/l	14.00
AGGREGATE ORGANIC CONSTITUENTS			
Carbonaceous Biochemical Oxygen Demand - CBOD (mg/l)	SM 5210.B	1 mg/l	28.55
Chemical Oxygen Demand	ASTM D1252	3 mg/l	17.85
Organic Carbon, Total	EPA 415.1	0.4 mg/l	26.00
METALS			
Arsenic, Dissolved	EPA 6010B	1 ug/l	12.50
Cadmium, Dissolved	EPA 6010B	0.2 ug/l	12.50
Chromium, Dissolved	EPA 6010B	10 ug/l	12.50
Copper, Dissolved	EPA 6010B	2 ug/l	12.50
Lead, Dissolved	EPA 6010B	0.5 ug/l	12.50
Mercury, Dissolved	EPA 6010B	0.05 ug/l	40.30
Nickel, Dissolved	EPA 6010B	10 ug/l	12.50
Zinc Dissolved	EPA 6010B	10 ug/l	12.50
PESTICIDES AND PCBs			
Organochlorine Pesticide and PCB Scan	EPA 8081 EPA 8082	See Table 6	165.00
Dieldrin (ug/l)	EPA - 8081	0.001	624.00
PCBs - Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260 (ug/l)	EPA - 8082	0.001	624.00
Total Laboratory Cost for Analyzing the Receiving Water Sample			**$1,623.55**

5.6. QUALITY CONTROL

Where applicable, field measurements and samples will be collected in accordance with SOPs developed by the USACE's Water Control and Water Quality Section.

Laboratory quality control samples and data quality indicators will be utilized in accordance with the Contract Laboratory Quality Assurance Manual. Routine internal quality control checks are placed in the measurement system to assess the quality of the data generated. These checks typically include: with each preparative batch, a Method Blank, a Matrix Spike and Matrix Spike Duplicate, a Laboratory Duplicate, and a Laboratory Control Sample. Inclusion of the Matrix Spike, Matrix Spike Duplicate and Laboratory Duplicate are contingent on sufficient sample material being provided. In addition to the checks within the preparative batch there are analysis batch checks that are also completed (retained on file by

the laboratory, but typically not reported in a standard data package) including Calibration Blanks, Initial Calibration Verifications, and Continuing Calibration Verifications. Additional samples are analyzed periodically (results retained on file) and may include reagent blanks, second source check standards and other performance checks. External quality control checks are provided in the form of Performance and System Audits and Surveillance. A laboratory Quality Assurance Report will be submitted to the District's Water Quality Unit on an appropriate basis.

6. DATA MANAGEMENT AND REPORTING

All water quality measurements and analyses will be verified, validated, and compiled into an excel spreadsheet. Once compiled, the results will be emailed to Luke Wallace (CENWO-PM-AE).

7. PROJECTED COSTS FOR FIELD COLLECTION AND LABORATORY ANALYSIS OF ELUTRIATE SAMPLES

Field Collection:

Preparation and collection of required samples 20 man hours @ $100 = $,2,000

Laboratory Analysis (Midwest Laboratories):

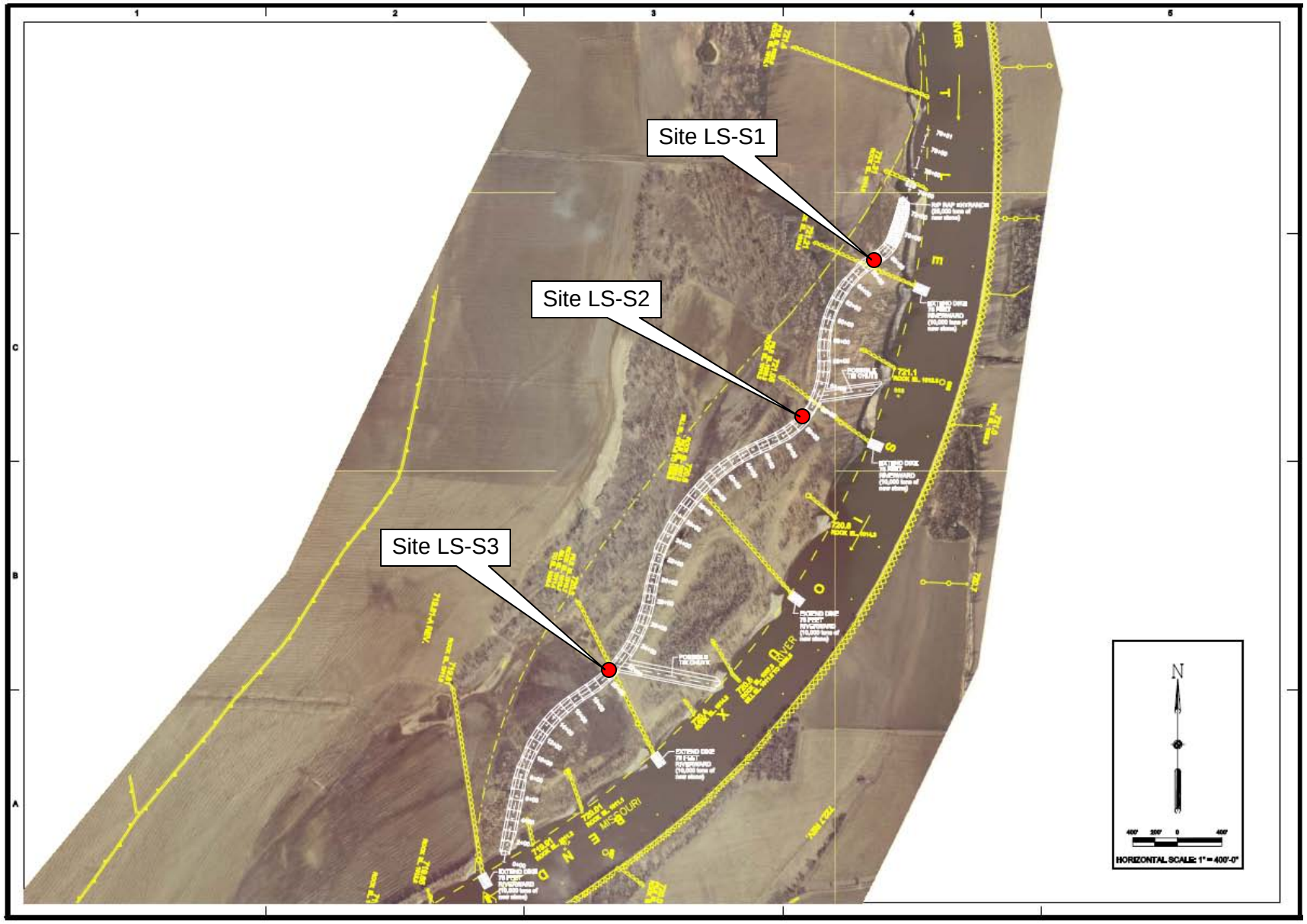
Analyzed Media	Number of Samples	Unit Cost per Sample	Total Cost
Soil	3	$559.75	$1,679.25
Elutriate - Filtered	3	$373.35	$1,120.05
Elutriate Supernatant	3	$1,703.40	$5,110.20
Receiving Water	1	$1,623.55	$1,623.55
TOTAL ANALYSTICAL COSTS			**$9,533.05**

Total Costs = $2,000.00 (Field Collection) + $9,533.05 (Lab Analysis) = $11,533.05

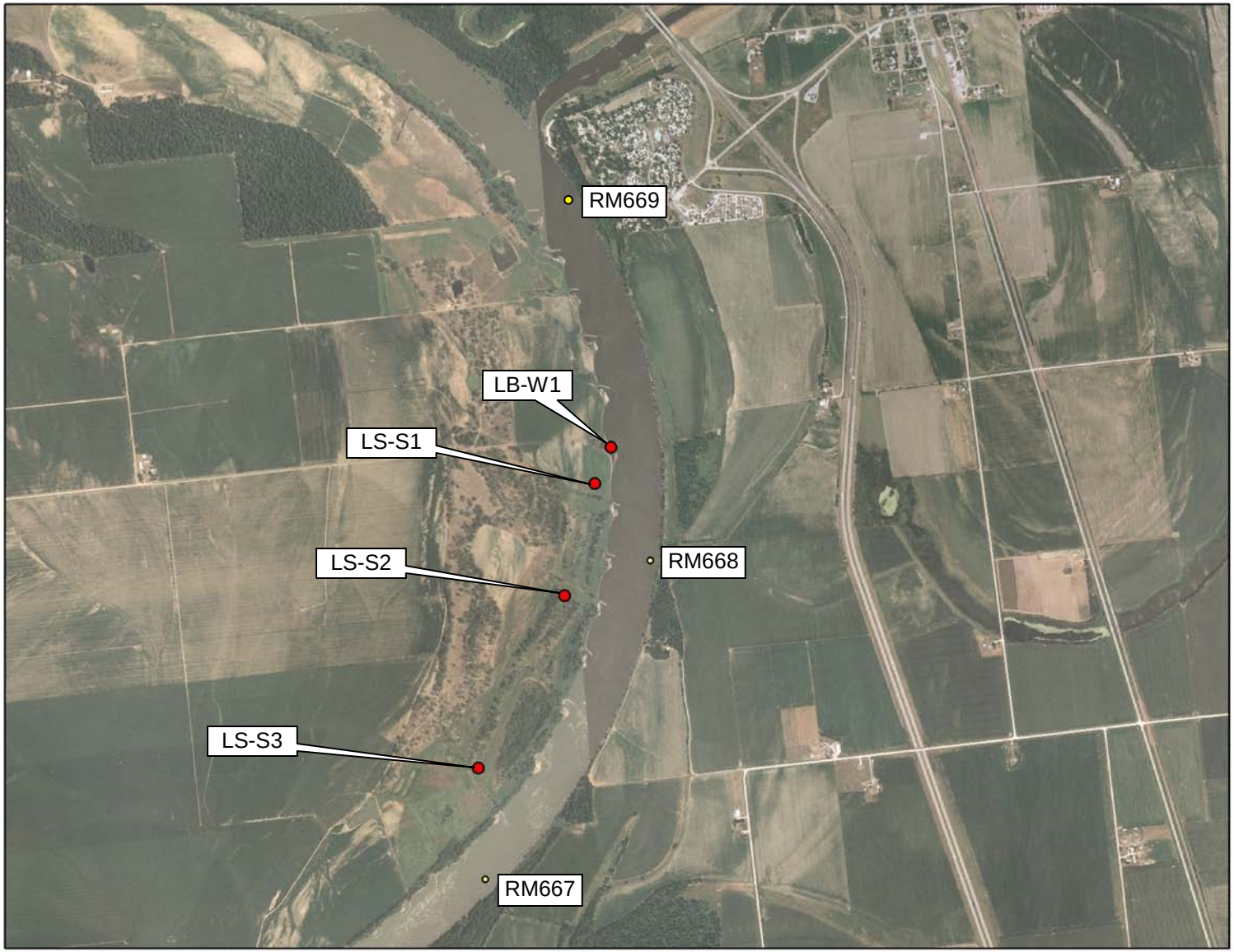
8. REFERENCES

USEPA and USACE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Test Manual: Inland Testing Manual. EPA-823-B-98-004, February 1998. U.S. Environmental Protection Agency, Office of Water. Department of Army, U.S. Army Corps of Engineers. Washington, D.C

ATTACHMENT 1. Little Sioux Bend Project Alignment and Sampling Sites..



ATTACHMENT 2. Little Sioux Bend Project Sampling Sites (shown on 2005 aerial photo).



ATTACHMENT 3. Field Sheet for Little Sioux Bend Elutriate Monitoring Project.

(U.S. Army Corps of Engineers – Omaha District – Water Quality Unit)

FIELD DATA SHEET

Project Name: Little Sioux Bend Elutriate Monitoring **Project Number:** SPS-LSXBND-001

Trip Number: _____ **Date:** _____

Site Location: Little Sioux Bend Project, Missouri River (RM668)

Site Numbers: LS-W1**,** LS-S1, LS-S2, LS-S3

Collectors: _____

GPS MEASUREMENTS

GPS Device Used: _____

Site LS-W1: Latitude: _____ Longitude: _____

Site LS-S1: Latitude: _____ Longitude: _____

Site LS-S2: Latitude: _____ Longitude: _____

Site LS-S3: Latitude: _____ Longitude: _____

WATER MEASUREMENTS

Water Quality Measurements:

Temp. (°C)	pH (S.U.)	Cond. (umho/cm)	D.O. (%Sat)	D.O. (mg/l)	Turbidity (NTUs)

SAMPLES COLLECTED

Sample Type	Sample ID	Sampled Depth	Collection Time	Sampling Method
Water Sample	LS-W1	Surface		Grab
Soil Sample	LS-S1			Composite Core
Soil Sample	LS-S2			Composite Core
Soil Sample	LS-S3			Composite Core

COMMENTS:

ATTACHMENT 4. Analytical Request Form for Little Sioux Bend Monitoring Project.

(U.S. Army Corps of Engineers – Omaha District – Water Quality Unit)

ANALYTICAL REQUEST FORM

Project Name: Little Sioux Bend Elutriate Monitoring **Project Number:** SPS-LSXBND-001

Trip Number: _____

Samples to be Analyzed:

Site Number	Sample Description	Sample Identification Number	Collection Date	Collection Time	Number of Sample Containers
LB-W1	Missouri River Overburden Water	LS-W1			12*
LS-S1	Soil Sample	LS-S1			1
LS-S2	Soil Sample	LS-S2			1
LS-S3	Soil Sample	LS-S3			1

* Assuming 1-gallon containers

Total Number of Sample Containers Delivered to Lab: _____

Samples Collected By: _____

Samples Delivered By: _____

Samples Received By: _____ **Date/Time Received:** _____

REQUESTED LABORATORY ANALYSES
(See Back of Page)

Comments:

REQUESTED LABORATORY ANALYSES				
Parameter	**Detection Limit**	**Soil**	**Receiving Water**	**Elutriate Water**
PHYSICAL AND AGGREGATE PROPERTIES				
pH	----	X		X
Particle Size	-----	X		
Total Suspended Solids	4 mg/l		X	X*
Turbidity	1 NTU			X*
NUTRIENTS				
Nitrogen, Ammonia as N, Total	0.02 mg/l	X	X	X*
Nitrogen, Total Kjeldahl as N	0.2 mg/l	X	X	X*
Nitrogen, Nitrate/Nitrite as N)	0.02 mg/l	X	X	X
Phosphorus, Dissolved	0.02 mg/l		X	X
Phosphorus, Total	0.02 mg/l	X	X	X*
Ortho-Phosphorus, Dissolved	0.02 mg/l		X	X
AGGREGATE ORGANIC CONSTITUENTS				
CBOD	1 mg/l		X	X*
Chemical Oxygen Demand	3 mg/l		X	X
Organic Carbon, Total	0.4 mg/l	X	X	X*
METALS (Dissolved)				
Arsenic, Dissolved	1 ug/l		X	X
Cadmium, Dissolved	0.2 ug/l		X	X
Chromium, Dissolved	10 ug/l		X	X
Copper, Dissolved	2 ug/l		X	X
Lead, Dissolved	0.5 ug/l		X	X
Mercury, Dissolved	0.05 ug/l		X	X
Nickel, Dissolved	10 ug/l		X	X
Zinc Dissolved	10 ug/l		X	X
METALS (Total)				
Arsenic, Total	10 mg/kg	X		
Cadmium, Total	0.2 mg/kg	X		
Chromium, Total	1 mg/kg	X		
Copper, Total	1 mg/kg	X		
Lead, Total	13 mg/kg	X		
Mercury, Total	0.1 mg/kg	X		
Nickel, Total	1 mg/kg	X		
Zinc Total	2 mg/kg	X		
PESTICIDES and PCBs				
Organochlorine Pesticide and PCB Scan	------	X	X	X*
Atrazine (ug/l)	0.05	X	X	X*
Dieldrin	0.001ug/l		X	X*
PCBs – Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260 (ug/l)	0.001ug/l		X	X*

* Determined on the “elutriate” supernatant prior to filtration.

ATTACHMENT 2

Particle Size Distribution Reports for Collected Sediment and Soil Samples.

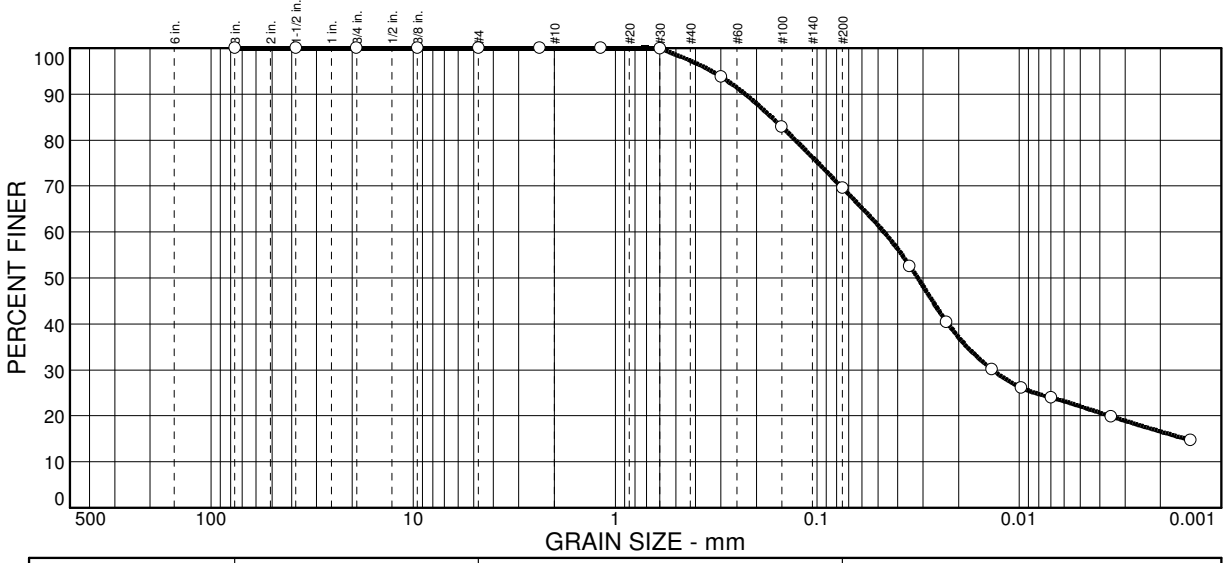
Midwest Laboratories, Inc.®
13611 B Street • Omaha, Nebraska 68144-3693 • (402) 334-7770 • FAX (402) 334-9121 • www.midwestlabs.com

Report Number
12-139-2152

Particle Size Distribution Report

Project: SPS-LSXBND-001 LITTLE SIOUX BEND ELUTRIATE MONITORING **Report No.:** 12-139-2152
Client: US ARMY CORPS OF ENGINEERS

Sample No: 1989040 **Source of Sample:** **Date:** 05/18/2012
Location: LS-S1 **Elev./Depth:**



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	2.7	27.7	47.5	22.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
1.5 in.	100.0		
.75 in.	100.0		
.375 in.	100.0		
#4	100.0		
#8	100.0		
#16	100.0		
#30	99.9		
#50	93.8		
#100	82.9		
#200	69.6		

* (no specification provided)

Soil Description

Atterberg Limits
PL= LL= PI=

Coefficients
D_{85}= 0.169 D_{60}= 0.0468 D_{50}= 0.0319
D_{30}= 0.0136 D_{15}= 0.0015 D_{10}=
C_u= C_c=

Classification
USCS= AASHTO=

Remarks

Figure

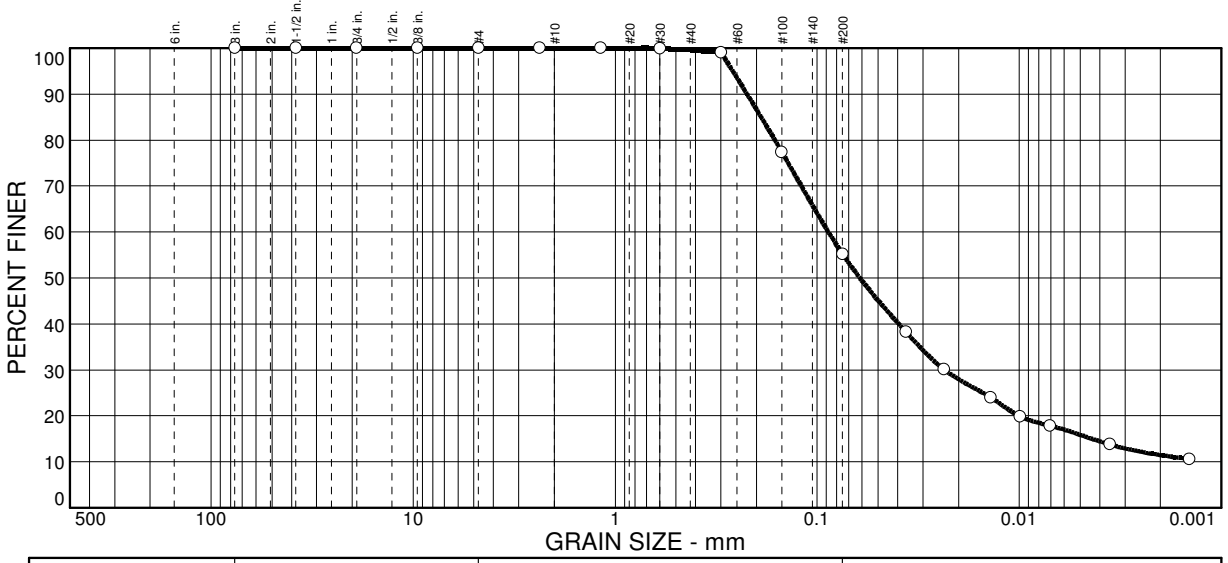
Midwest Laboratories, Inc.®
13611 B Street • Omaha, Nebraska 68144-3693 • (402) 334-7770 • FAX (402) 334-9121 • www.midwestlabs.com

Report Number
12-139-2153

Particle Size Distribution Report

Project: SPS-LSXBND-001 LITTLE SIOUX BEND ELUTRIATE MONITORING **Report No.:** 12-139-2153
Client: US ARMY CORPS OF ENGINEERS

Sample No: 1989041 **Source of Sample:** **Date:** 05/18/2012
Location: LS-S2 **Elev./Depth:**



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.4	44.4	39.3	15.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
1.5 in.	100.0		
.75 in.	100.0		
.375 in.	100.0		
#4	100.0		
#8	100.0		
#16	100.0		
#30	99.9		
#50	99.1		
#100	77.4		
#200	55.2		

* (no specification provided)

Soil Description

Atterberg Limits
PL= LL= PI=

Coefficients
D_{85}= 0.190 D_{60}= 0.0882 D_{50}= 0.0616
D_{30}= 0.0235 D_{15}= 0.0044 D_{10}=
C_u= C_c=

Classification
USCS= AASHTO=

Remarks

Figure

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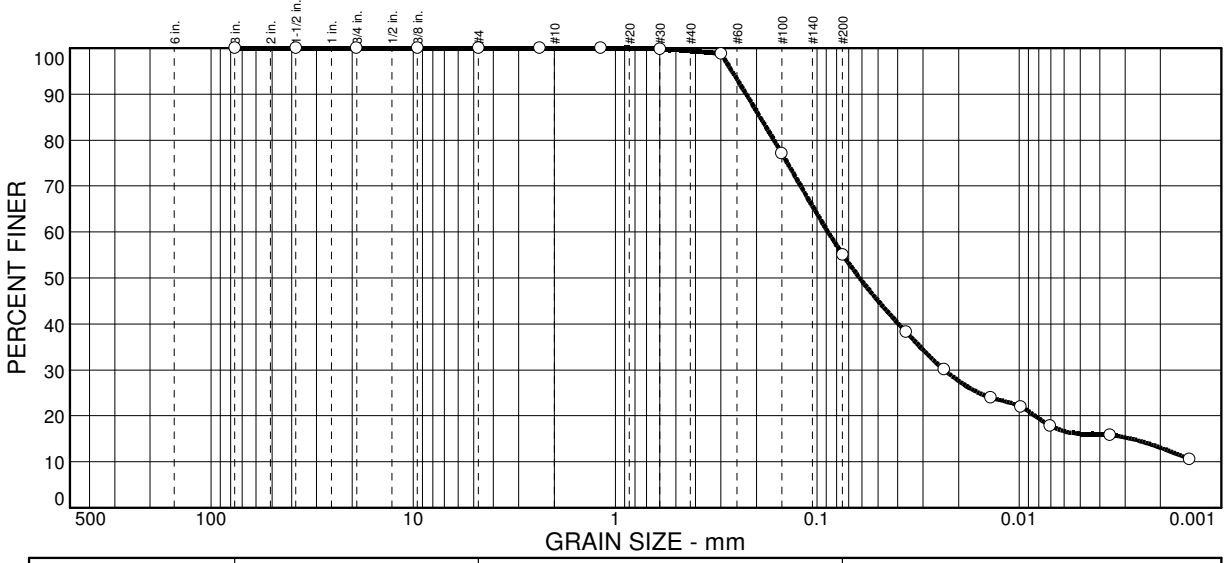
Report Number
12-139-2153

Particle Size Distribution Report

Project: SPS-LSXBND-001 LITTLE SIOUX BEND ELUTRIATE MONITORING **Report No.:** 12-139-2153
Client: US ARMY CORPS OF ENGINEERS

Sample No: 1989041 DUP **Source of Sample:** **Date:** 05/18/2012
Location: LS-S2 DUP **Elev./Depth:**



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.6	44.3	39.0	16.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
1.5 in.	100.0		
.75 in.	100.0		
.375 in.	100.0		
#4	100.0		
#8	100.0		
#16	100.0		
#30	99.8		
#50	98.8		
#100	77.1		
#200	55.1		

* (no specification provided)

Soil Description

Atterberg Limits
PL= LL= PI=

Coefficients
D_{85}= 0.192 D_{60}= 0.0886 D_{50}= 0.0618
D_{30}= 0.0235 D_{15}= 0.0028 D_{10}=
C_u= C_c=

Classification
USCS= AASHTO=

Remarks

Figure

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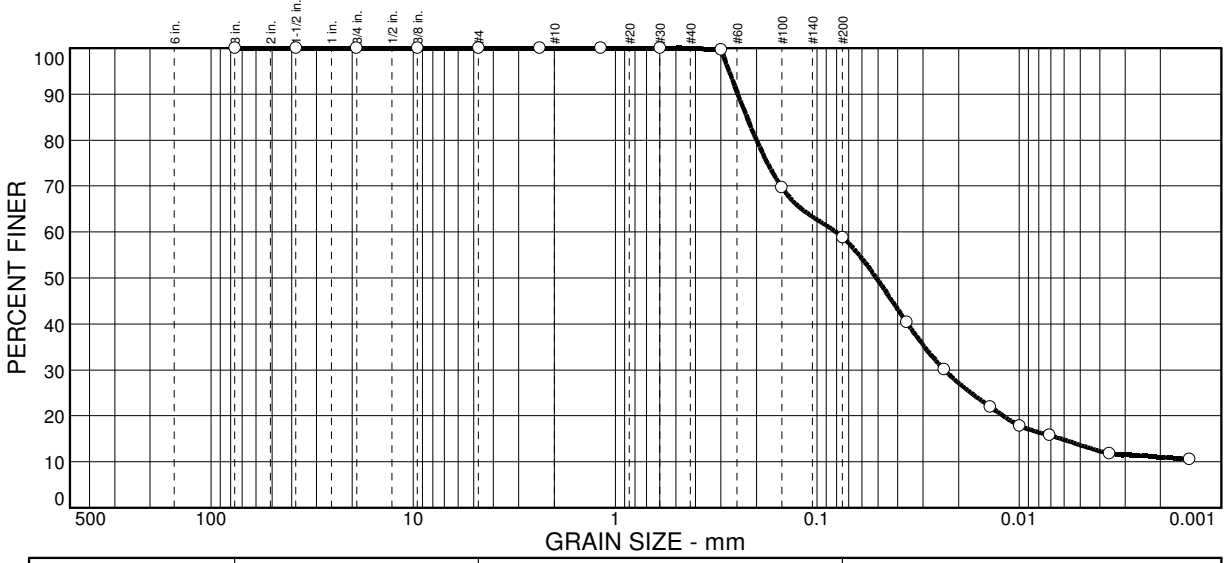
Report Number
12-139-2154

Particle Size Distribution Report

Project: SPS-LSXBND-001 LITTLE SIOUX BEND ELUTRIATE MONITORING **Report No.:** 12-139-2154
Client: US ARMY CORPS OF ENGINEERS

Sample No: 1989042 **Source of Sample:** **Date:** 05/18/2012
Location: LS-S3 **Elev./Depth:**



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	41.1	45.1	13.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
1.5 in.	100.0		
.75 in.	100.0		
.375 in.	100.0		
#4	100.0		
#8	100.0		
#16	100.0		
#30	100.0		
#50	99.7		
#100	69.7		
#200	58.8		

* (no specification provided)

Soil Description

Atterberg Limits
PL= LL= PI=

Coefficients
D_{85}= 0.223 D_{60}= 0.0810 D_{50}= 0.0511
D_{30}= 0.0235 D_{15}= 0.0062 D_{10}=
C_u= C_c=

Classification
USCS= AASHTO=

Remarks

Figure

ATTACHMENT 3

Laboratory Reports of Results for Analysis of Collected Sediment, Soil, Receiving Water, and Prepared Elutriate Samples.

Midwest Laboratories

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REPORT # 12-144-2257
12-152-2042
12-144-2256

USACE
DAVE JENSEN
106 SOUTH 15TH STREET
OMAHA NE 68102

Project Name: LITTLE SIOUX BEND ELUTRIATE MONITORING
Project #: SPS-LSXBND-001
Trip Number: EDXEJ050912

Lab Number:						1989043	1989039		1989046	
Sample ID:						LS-S1	LB-W1		LS-S1	
Parameter	Method	Method Detection Limit		Laboratory Reporting Limit		Units	Soil	Receiving Water Total	Receiving Water Dissolved	Elutriate Water Total	Elutriate Water Dissolved
Ammonia as N	EPA 350.2	0.2	0.02	1	0.1	mg/kg mg/L	73	0.08 J	0.08 J	0.09 J	0.09 J
Arsenic	EPA 200.8	1	1	5	3	mg/kg µg/L	n.d		3		4
Cadmium	EPA 200.8	0.5	0.2	2	1	mg/kg µg/L	1.23	---	n.d	---	n.d
Carbonaceous Biochemical Oxygen Demand - CBOD	SM 5210.B	-	2	-	5	mg/L	---	2 J	---	n.d	---
Chemical Oxygen Demand-COD	ASTM 1252	-	3	-	10	mg/L	---	19	16	18	16
Chromium	EPA 200.7	0.2	4	1	10	mg/kg µg/L	13.6	---	9 J	---	9 J
Copper	EPA 200.7	0.2	2	1.0	10	mg/kg µg/L	14.9	---	4 J	---	11
Kjeldahl Nitrogen (Total or N)	EPA 351.3	2	0.2	10	0.5	mg/kg mg/L	580	1.8	1.1	1.4	1.1
Lead	EPA 200.8	1	0.5	5	2	mg/kg µg/L	9.4	---	n.d	---	n.d
Mercury	EPA 245.1	0.2	0.02	1	0.05	mg/kg µg/L	n.d	---	n.d	---	n.d
Nickel	EPA 200.7	0.2	2	2	10	mg/kg µg/L	17.2	---	8 J	---	15
Nitrate/Nitrite Nitrogen	EPA 353.2	0.2	0.02	1	0.05	mg/kg mg/L	4.8	---	1.2	---	2.1
Organochlorine Pesticides	EPA 8081	-	-	*	*	---	n.d.* Page 2	n.d.* Page 3	---	---	n.d.* Page 4
Polychlorinated Biphenyls (PCB's)	EPA 8082	-	-	*	*	---	n.d.* Page 2	n.d.* Page 3	---	---	n.d.* Page 4
Percent Solids	SM 2540G	0.01	-	1	---	%	71.3	---	---	---	---
Particle Size	Sieve	---	---	---	---	---	See Attached	---	---	---	---
pH	SM 4500-H	0.1		0.2		---	8.1	8.29	---	8.19	---
Total Organic Carbon - TOC	SM 5310B	2	0.2	10	1	mg/kg mg/L	8,800	13.5	4	7.4	4.4
Total Phosphorus	SM 4500 P-F	0.2	0.02	1	0.05	mg/kg mg/L	383	0.27	0.1	0.3	0.14
Total Suspended Solids	SM 2540D	-	4	-	10	mg/L	---	362	---	136	---
Turbidity- Total	EPA 180.1	-	1	-	3	NTU	---	206	---	207	
Turbidity- Dissolved	EPA 180.1	---	1	---	3	NTU	---	---	n.d	---	n.d
Zinc	EPA 200.7	1	4	5	10	mg/kg µg/L	52.8	---	53	---	62

n.d. = Not Detected
--- Test not requested/Applicable
J = Estimated concentration below laboratory reporting limit.
* See attached report

Note:
- Elutriate Extract were analyzed for organic analysis after settling time of one (1) hour and the samples were not filtered

Prem N. Arora

Prem N. Arora, Environmental Project Manager

Midwest Laboratories

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REPORT OF ANALYSIS

Report Number: 12-152-2042

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONIT
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989043 **Sample ID:** LS-S1

Method: EPA 8081/8082 **Units:** µg/Kg **Analyst:** nmh **Date of Analysis:** 5/16/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/Kg)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
4,4'-DDE	n.d.	0.003	9.9	Endosulfan I	n.d.	0.002	5.1
4,4'-DDD	n.d.	0.0005	9.9	Endosulfan II	n.d.	0.0008	9.9
4,4'-DDT	n.d.	0.0003	9.9	Endosulfan sulfate	n.d.	0.0008	9.9
4,4'-Methoxychlor	n.d.	0.002	51	Endrin	n.d.	0.002	9.9
Aldrin	n.d.	0.001	5.1	Endrin aldehyde	n.d.	0.0008	9.9
Aroclor 1016	n.d.	0.009	50	Endrin ketone	n.d.	0.003	9.9
Aroclor 1221	n.d.	NA	50	Heptachlor	n.d.	0.002	5.1
Aroclor 1232	n.d.	NA	50	Heptachlor epoxide	n.d.	0.0008	5.1
Aroclor 1242	n.d.	0.02	50	alpha-Chlordane	n.d.	0.005	5.1
Aroclor 1248	n.d.	0.009	50	alpha-BHC	n.d.	0.0008	5.1
Aroclor 1254	n.d.	0.02	50	beta- BHC	n.d.	0.002	5.1
Aroclor 1260	n.d.	0.02	50	delta-BHC	n.d.	0.0008	5.1
Aroclor 1262	n.d.	NA	50	gama-BHC (Lindane)	n.d.	0.0008	5.1
Aroclor 1268	n.d.	NA	50	gama-(Chlordane)	n.d.	0.009	5.1
Dieldrin	n.d.	0.0003	9.9				

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REPORT OF ANALYSIS

Report Number: 12-144-2257

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MON
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989039 **Sample ID:** LB-W1-MISSOURI RIVER OVERBURDEN WATER

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/15/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
4,4'-DDE	n.d.	0.003	0.10	Endosulfan I	n.d.	0.005	0.05
4,4'-DDD	n.d.	0.004	0.10	Endosulfan II	n.d.	0.003	0.10
4,4'-DDT	n.d.	0.009	0.10	Endosulfan sulfate	n.d.	0.002	0.10
4,4'-Methoxychlor	n.d.	0.01	0.50	Endrin	n.d.	0.004	0.10
Aldrin	n.d.	0.004	0.50	Endrin aldehyde	n.d.	0.004	0.10
Aroclor 1016	n.d.	0.08	1.00	Endrin ketone	n.d.	0.006	0.10
Aroclor 1221	n.d.	0.01	2.00	Heptachlor	n.d.	0.005	0.05
Aroclor 1232	n.d.	0.01	1.00	Heptachlor epoxide	n.d.	0.04	0.05
Aroclor 1242	n.d.	0.01	1.00	alpha-Chlordane	n.d.	0.04	0.05
Aroclor 1248	n.d.	0.01	1.00	alpha-BHC	n.d.	0.001	0.05
Aroclor 1254	n.d.	0.01	1.00	beta- BHC	n.d.	0.005	0.05
Aroclor 1260	n.d.	0.01	1.00	delta-BHC	n.d.	0.005	0.05
Aroclor 1262	n.d.	0.01	1.00	gama-BHC (Lindane)	n.d.	0.001	0.05
Aroclor 1268	n.d.	0.01	1.00	gama-(Chlordane)	n.d.	0.005	0.05
Dieldrin	n.d.	0.01	0.10				

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REPORT OF ANALYSIS

Report Number: 12-144-2256

Reported to:
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ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MON
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989046 **Sample ID:** LS-S1 ELUTRIATE

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/18/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
4,4'-DDE	n.d.	0.003	0.10	Endosulfan I	n.d.	0.005	0.05
4,4'-DDD	n.d.	0.004	0.10	Endosulfan II	n.d.	0.003	0.10
4,4'-DDT	n.d.	0.009	0.10	Endosulfan sulfate	n.d.	0.002	0.10
4,4'-Methoxychlor	n.d.	0.01	0.50	Endrin	n.d.	0.004	0.10
Aldrin	n.d.	0.004	0.50	Endrin aldehyde	n.d.	0.004	0.10
Aroclor 1016	n.d.	0.08	1.00	Endrin ketone	n.d.	0.006	0.10
Aroclor 1221	n.d.	0.01	2.00	Heptachlor	n.d.	0.005	0.05
Aroclor 1232	n.d.	0.01	1.00	Heptachlor epoxide	n.d.	0.04	0.05
Aroclor 1242	n.d.	0.01	1.00	alpha-Chlordane	n.d.	0.04	0.05
Aroclor 1248	n.d.	0.01	1.00	alpha-BHC	n.d.	0.001	0.05
Aroclor 1254	n.d.	0.01	1.00	beta- BHC	n.d.	0.005	0.05
Aroclor 1260	n.d.	0.01	1.00	delta-BHC	n.d.	0.005	0.05
Aroclor 1262	n.d.	0.01	1.00	gama-BHC (Lindane)	n.d.	0.001	0.05
Aroclor 1268	n.d.	0.01	1.00	gama-(Chlordane)	n.d.	0.005	0.05
Dieldrin	n.d.	0.01	0.10				

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REPORT OF ANALYSIS

Report Number: 12-144-2257

Reported to:
US ARMY CORPS OF
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1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORING
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Low Level Analysis

Lab number: 1989039 **Sample ID:** LB-W1-MISSOURI RIVER OVERBURDEN WATER

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/15/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
Aroclor 1016	n.d.	0.0002	0.001
Aroclor 1221	n.d.	0.0003	0.001
Aroclor 1232	n.d.	0.0003	0.001
Aroclor 1242	n.d.	0.0003	0.001
Aroclor 1248	n.d.	0.0004	0.001
Aroclor 1254	n.d.	0.0003	0.001
Aroclor 1260	n.d.	0.0004	0.001
Aroclor 1262	n.d.	0.0004	0.001
Aroclor 1268	n.d.	0.0003	0.001
Dieldrin	n.d.	0.0002	0.001

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REPORT OF ANALYSIS

Report Number: 12-144-2256

Reported to:
US ARMY CORPS OF
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OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORING
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Low Level Analysis

Lab number: 1989046 **Sample ID:** LS-S1 ELUTRIATE

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/18/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
Aroclor 1016	n.d.	0.0002	0.001
Aroclor 1221	n.d.	0.0003	0.001
Aroclor 1232	n.d.	0.0003	0.001
Aroclor 1242	n.d.	0.0003	0.001
Aroclor 1248	n.d.	0.0004	0.001
Aroclor 1254	n.d.	0.0003	0.001
Aroclor 1260	n.d.	0.0004	0.001
Aroclor 1262	n.d.	0.0004	0.001
Aroclor 1268	n.d.	0.0003	0.001
Dieldrin	n.d.	0.0002	0.001

Midwest Laboratories

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REPORT # 12-144-2257
12-152-2043
12-144-2255

USACE
DAVE JENSEN
106 SOUTH 15TH STREET
OMAHA NE 68102

Project Name: LITTLE SIOUX BEND ELUTRIATE MONITORING
Project #: SPS-LSXBND-001
Trip Number: EDXEJ050912

Lab Number:						1989044	1989039		1989047	
Sample ID:						LS-S2	LB-W1		LS-S2	
Parameter	Method	Method Detection Limit		Laboratory Reporting Limit		Units	Soil	Receiving Water Total	Receiving Water Dissolved	Elutriate Water Total	Elutriate Water Dissolved
Ammonia as N	EPA 350.2	0.2	0.02	1	0.1	mg/kg mg/L	54	0.08 J	0.08 J	0.68	0.67
Arsenic	EPA 200.8	1	1	5	3	mg/kg µg/L	n.d	---	3	---	6
Cadmium	EPA 200.8	0.5	0.2	2	1	mg/kg µg/L	0.99	---	n.d	---	n.d
Carbonaceous Biochemical Oxygen Demand - CBOD	SM 5210.B	-	2	-	5	mg/L	---	2 J	---	2 J	---
Chemical Oxygen Demand-COD	ASTM 1252	-	3	-	10	mg/L	---	19	16	13	16
Chromium	EPA 200.7	0.2	4	1	10	mg/kg µg/L	12	---	9 J	---	9 J
Copper	EPA 200.7	0.2	2	1.0	10	mg/kg µg/L	13	---	4 J	---	9 J
Kjeldahl Nitrogen (Total or N)	EPA 351.3	2	0.2	10	0.5	mg/kg mg/L	383	1.8	1.1	1.4	1.1
Lead	EPA 200.8	1	0.5	5	2	mg/kg µg/L	7.5	---	n.d	---	5
Mercury	EPA 245.1	0.2	0.02	1	0.05	mg/kg µg/L	n.d	---	n.d	---	n.d
Nickel	EPA 200.7	0.2	2	2	10	mg/kg µg/L	15.4	---	8J	---	12
Nitrate/Nitrite Nitrogen	EPA 353.2	0.2	0.02	1	0.05	mg/kg mg/L	2.8	---	1.2	---	1.1
Organochlorine Pesticides	EPA 8081	-	-	*	*	---	n.d.* Page 2	n.d.* Page 3	---	---	n.d.* Page 4
Polychlorinated Biphenyls (PCB's)	EPA 8082	-	-	*	*	---	n.d.* Page 2	n.d.* Page 3	---	---	n.d.* Page 4
Percent Solids	SM 2540G	0.01	-	1	---	%	73.61	---	---	---	---
Particle Size	Sieve	---	---	---	---	---	See Attached	---	---	---	---
pH	SM 4500-H	0.1		0.2		---	7.7	8.34	---	7.72	---
Total Organic Carbon - TOC	SM 5310B	2	0.2	10	1	mg/kg mg/L	7,900	13.5	0.10	7.6	4.5
Total Phosphorus	SM 4500 P-F	0.2	0.02	1	0.05	mg/kg mg/L	506	0.27	0.10	0.16	0.10
Total Suspended Solids	SM 2540D	-	4	-	10	mg/L	---	362	---	149	---
Turbidity- Total	EPA 180.1	-	1	-	3	NTU	---	206	---	207	
Turbidity- Dissolved	EPA 180.1	---	1	---	3	NTU	---	---	n.d	---	n.d
Zinc	EPA 200.7	1	4	5	10	mg/kg µg/L	45.1	---	53	---	66

n.d. = Not Detected
--- Test not requested/Applicable
J = Estimated concentration below laboratory reporting limit.
* See attached report

Note:
- Elutriate Extract were analyzed for organic analysis after settling time of one (1) hour and the samples were not filtered

Prem N. Arora

Prem N. Arora, Environmental Project Manager

Midwest Laboratories

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REPORT OF ANALYSIS

Report Number: 12-152-2043

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITOI
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989044 **Sample ID:** LS-S2

Method: EPA 8081/8082 **Units:** µg/Kg **Analyst:** nmh **Date of Analysis:** 5/16/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/Kg)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/Kg)
4,4'-DDE	n.d.	0.003	9.9	Endosulfan I	n.d.	0.002	5.1
4,4'-DDD	n.d.	0.0005	9.9	Endosulfan II	n.d.	0.0008	9.9
4,4'-DDT	n.d.	0.0003	9.9	Endosulfan sulfate	n.d.	0.0008	9.9
4,4'-Methoxychlor	n.d.	0.002	51	Endrin	n.d.	0.002	9.9
Aldrin	n.d.	0.001	5.1	Endrin aldehyde	n.d.	0.0008	9.9
Aroclor 1016	n.d.	0.009	50	Endrin ketone	n.d.	0.003	9.9
Aroclor 1221	n.d.	NA	50	Heptachlor	n.d.	0.002	5.1
Aroclor 1232	n.d.	NA	50	Heptachlor epoxide	n.d.	0.0008	5.1
Aroclor 1242	n.d.	0.02	50	alpha-Chlordane	n.d.	0.005	5.1
Aroclor 1248	n.d.	0.009	50	alpha-BHC	n.d.	0.00085	5.1
Aroclor 1254	n.d.	0.02	50	beta- BHC	n.d.	0.002	5.1
Aroclor 1260	n.d.	0.02	50	delta-BHC	n.d.	0.0008	5.1
Aroclor 1262	n.d.	NA	50	gama-BHC (Lindane)	n.d.	0.0008	5.1
Aroclor 1268	n.d.	NA	50	gama-(Chlordane)	n.d.	0.009	5.1
Dieldrin	n.d.	0.0003	9.9				

Midwest Laboratories

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REPORT OF ANALYSIS

Report Number: 12-144-2257

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MON
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989039 **Sample ID:** LB-W1-MISSOURI RIVER OVERBURDEN WATER

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/15/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
4,4'-DDE	n.d.	0.003	0.10	Endosulfan I	n.d.	0.005	0.05
4,4'-DDD	n.d.	0.004	0.10	Endosulfan II	n.d.	0.003	0.10
4,4'-DDT	n.d.	0.009	0.10	Endosulfan sulfate	n.d.	0.002	0.10
4,4'-Methoxychlor	n.d.	0.01	0.50	Endrin	n.d.	0.004	0.10
Aldrin	n.d.	0.004	0.50	Endrin aldehyde	n.d.	0.004	0.10
Aroclor 1016	n.d.	0.08	1.00	Endrin ketone	n.d.	0.006	0.10
Aroclor 1221	n.d.	0.01	2.00	Heptachlor	n.d.	0.005	0.05
Aroclor 1232	n.d.	0.01	1.00	Heptachlor epoxide	n.d.	0.04	0.05
Aroclor 1242	n.d.	0.01	1.00	alpha-Chlordane	n.d.	0.04	0.05
Aroclor 1248	n.d.	0.01	1.00	alpha-BHC	n.d.	0.001	0.05
Aroclor 1254	n.d.	0.01	1.00	beta- BHC	n.d.	0.005	0.05
Aroclor 1260	n.d.	0.01	1.00	delta-BHC	n.d.	0.005	0.05
Aroclor 1262	n.d.	0.01	1.00	gama-BHC (Lindane)	n.d.	0.001	0.05
Aroclor 1268	n.d.	0.01	1.00	gama-(Chlordane)	n.d.	0.005	0.05
Dieldrin	n.d.	0.01	0.10				

Midwest Laboratories

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REPORT OF ANALYSIS

Report Number: 12-144-2255

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORING
TRIP NUMBER EDXEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989047 **Sample ID:** LS-S2 ELUTRIATE

Method: EPA 8081A/8 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/18/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
4,4'-DDE	n.d.	0.003	0.10	Endosulfan I	n.d.	0.005	0.05
4,4'-DDD	n.d.	0.004	0.10	Endosulfan II	n.d.	0.003	0.10
4,4'-DDT	n.d.	0.009	0.10	Endosulfan sulfate	n.d.	0.002	0.10
4,4'-Methoxychlor	n.d.	0.01	0.50	Endrin	n.d.	0.004	0.10
Aldrin	n.d.	0.004	0.50	Endrin aldehyde	n.d.	0.004	0.10
Aroclor 1016	n.d.	0.08	1.00	Endrin ketone	n.d.	0.006	0.10
Aroclor 1221	n.d.	0.01	2.00	Heptachlor	n.d.	0.005	0.05
Aroclor 1232	n.d.	0.01	1.00	Heptachlor epoxide	n.d.	0.04	0.05
Aroclor 1242	n.d.	0.01	1.00	alpha-Chlordane	n.d.	0.04	0.05
Aroclor 1248	n.d.	0.01	1.00	alpha-BHC	n.d.	0.001	0.05
Aroclor 1254	n.d.	0.01	1.00	beta- BHC	n.d.	0.005	0.05
Aroclor 1260	n.d.	0.01	1.00	delta-BHC	n.d.	0.005	0.05
Aroclor 1262	n.d.	0.01	1.00	gama-BHC (Lindane)	n.d.	0.001	0.05
Aroclor 1268	n.d.	0.01	1.00	gama-(Chlordane)	n.d.	0.005	0.05
Dieldrin	n.d.	0.01	0.10				

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REPORT OF ANALYSIS

Report Number: 12-144-2257

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORING
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Low Level Analysis

Lab number: 1989039 **Sample ID:** LB-W1-MISSOURI RIVER OVERBURDEN WATER

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/15/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
Aroclor 1016	n.d.	0.0002	0.001
Aroclor 1221	n.d.	0.0003	0.001
Aroclor 1232	n.d.	0.0003	0.001
Aroclor 1242	n.d.	0.0003	0.001
Aroclor 1248	n.d.	0.0004	0.001
Aroclor 1254	n.d.	0.0003	0.001
Aroclor 1260	n.d.	0.0004	0.001
Aroclor 1262	n.d.	0.0004	0.001
Aroclor 1268	n.d.	0.0003	0.001
Dieldrin	n.d.	0.0002	0.001

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REPORT OF ANALYSIS

Report Number: 12-144-2255

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORING
TRIP NUMBER EDXEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989047 **Sample ID:** Low Level Analysis LS-S2 ELUTRIATE

Method: EPA 8081A/8 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/18/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
Aroclor 1016	n.d.	0.0002	0.001
Aroclor 1221	n.d.	0.0003	0.001
Aroclor 1232	n.d.	0.0003	0.001
Aroclor 1242	n.d.	0.0003	0.001
Aroclor 1248	n.d.	0.0003	0.001
Aroclor 1254	n.d.	0.0003	0.001
Aroclor 1260	n.d.	0.0004	0.001
Aroclor 1262	n.d.	0.0004	0.001
Aroclor 1268	n.d.	0.0003	0.001
Dieldrin	n.d.	0.0002	0.001

Midwest Laboratories

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REPORT # 12-144-2257
12-152-2044
12-144-2254

USACE
DAVE JENSEN
106 SOUTH 15TH STREET
OMAHA NE 68102

Project Name: LITTLE SIOUX BEND ELUTRIATE MONITORING
Project #: SPS-LSXBND-001
Trip Number: EDXEJ050912

Lab Number:						1989045	1989039		1989048	
Sample ID:						LS-S3	LB-W1		LS-S3	
Parameter	Method	Method Detection Limit		Laboratory Reporting Limit		Units	Soil	Receiving Water Total	Receiving Water Dissolved	Elutriate Water Total	Elutriate Water Dissolved
Ammonia as N	EPA 350.2	0.2	0.02	1	0.1	mg/kg mg/L	18	0.11	---	0.09 J	0.09 J
Arsenic	EPA 200.8	1	1	5	3	mg/kg µg/L	n.d	---	3	---	7
Cadmium	EPA 200.8	0.5	0.2	2	1	mg/kg µg/L	0.71	---	n.d	---	n.d
Carbonaceous Biochemical Oxygen Demand - CBOD	SM 5210.B	-	2	-	5	mg/L	---	2 J	---	n.d	---
Chemical Oxygen Demand-COD	ASTM 1252	-	3	-	10	mg/L	---	19	16	16	13
Chromium	EPA 200.7	0.2	4	1	10	mg/kg µg/L	10.5	---	9 J	---	15
Copper	EPA 200.7	0.2	2	1.0	10	mg/kg µg/L	8.4	---	4 J	---	15
Kjeldahl Nitrogen (Total or N)	EPA 351.3	2	0.2	10	0.5	mg/kg mg/L	293	1.8	1.1	1.5	1.0
Lead	EPA 200.8	1	0.5	5	2	mg/kg µg/L	6.2	---	n.d	---	7
Mercury	EPA 245.1	0.2	0.02	1	0.05	mg/kg µg/L	n.d	---	n.d	---	n.d
Nickel	EPA 200.7	0.2	2	2	10	mg/kg µg/L	13.5	---	8 J	---	21
Nitrate/Nitrite Nitrogen	EPA 353.2	0.2	0.02	1	0.05	mg/kg mg/L	2.8	0.3	1.2	---	1.7
Organochlorine Pesticides	EPA 8081	-	-	*	*	---	n.d.* Page 2	n.d.* Page 3	---	---	n.d.* Page 4
Polychlorinated Biphenyls (PCB's)	EPA 8082	-	-	*	*	---	n.d.* Page 2	n.d.* Page 3	---	---	n.d.* Page 4
Percent Solids	SM 2540G	0.01	-	1	---	%	84.61	---	---	---	---
Particle Size	Sieve	---	---	---	---	---	See Attached	---	---	---	---
pH	SM 4500-H	0.1		0.2		---	8.3	8.34	---	7.88	---
Total Organic Carbon - TOC	SM 5310B	2	0.2	10	1	mg/kg mg/L	3,700	13.5	---	9.6	4.4
Total Phosphorus	SM 4500 P-F	0.2	0.02	1	0.05	mg/kg mg/L	419	0.27	---	0.27	0.14
Total Suspended Solids	SM 2540D	-	4	-	10	mg/L	---	362	---	249	---
Turbidity-Total	EPA 180.1	-	1	-	3	NTU	---	206	---	246	
Turbidity- Dissolved	EPA 180.1	---	1	---	3	NTU	---	---	n.d	---	n.d
Zinc	EPA 200.7	1	4	5	10	mg/kg µg/L	33.8	---	53	---	56

n.d. = Not Detected
--- Test not requested/Applicable
J = Estimated concentration below laboratory reporting limit.
* See attached report

Note:
- Elutriate Extract were analyzed for organic analysis after settling time of one (1) hour and the samples were not filtered

Prem N. Arora

Prem N. Arora, Environmental Project Manager

Midwest Laboratories

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REPORT OF ANALYSIS

Report Number: 12-152-2044

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORING
TRIP NUMBER EDXDEJ050912

Date Repo 7/31/2012
Date Rece 5/9/2012
Date Samp 5/9/2012

Lab number: 1989045 **Sample ID:** LS-S3 SOIL SAMPLE

Method: EPA 8081/8082 **Units:** µg/Kg **Analyst:** nmh **Date of Analysis:** 5/16/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/Kg)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/Kg)
4,4'-DDE	n.d.	0.003	9.9	Endosulfan I	n.d.	0.002	5.1
4,4'-DDD	n.d.	0.0005	9.9	Endosulfan II	n.d.	0.0008	9.9
4,4'-DDT	n.d.	0.0003	9.9	Endosulfan sulfate	n.d.	0.0008	9.9
4,4'-Methoxychlor	n.d.	0.002	51	Endrin	n.d.	0.002	9.9
Aldrin	n.d.	0.001	5.1	Endrin aldehyde	n.d.	0.0008	9.9
Aroclor 1016	n.d.	0.009	50	Endrin ketone	n.d.	0.003	9.9
Aroclor 1221	n.d.	NA	50	Heptachlor	n.d.	0.002	5.1
Aroclor 1232	n.d.	NA	50	Heptachlor epoxide	n.d.	0.0008	5.1
Aroclor 1242	n.d.	0.02	50	alpha-Chlordane	n.d.	0.005	5.1
Aroclor 1248	n.d.	0.009	50	alpha-BHC	n.d.	0.00085	5.1
Aroclor 1254	n.d.	0.02	50	beta- BHC	n.d.	0.002	5.1
Aroclor 1260	n.d.	0.02	50	delta-BHC	n.d.	0.0008	5.1
Aroclor 1262	n.d.	NA	50	gama-BHC (Lindane)	n.d.	0.0008	5.1
Aroclor 1268	n.d.	NA	50	gama-(Chlordane)	n.d.	0.009	5.1
Dieldrin	n.d.	0.0003	9.9				

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REPORT OF ANALYSIS

Report Number: 12-144-2257

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MON
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Lab number: 1989039 **Sample ID:** LB-W1-MISSOURI RIVER OVERBURDEN WATER

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/15/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
4,4'-DDE	n.d.	0.003	0.10	Endosulfan I	n.d.	0.005	0.05
4,4'-DDD	n.d.	0.004	0.10	Endosulfan II	n.d.	0.003	0.10
4,4'-DDT	n.d.	0.009	0.10	Endosulfan sulfate	n.d.	0.002	0.10
4,4'-Methoxychlor	n.d.	0.01	0.50	Endrin	n.d.	0.004	0.10
Aldrin	n.d.	0.004	0.50	Endrin aldehyde	n.d.	0.004	0.10
Aroclor 1016	n.d.	0.08	1.00	Endrin ketone	n.d.	0.006	0.10
Aroclor 1221	n.d.	0.01	2.00	Heptachlor	n.d.	0.005	0.05
Aroclor 1232	n.d.	0.01	1.00	Heptachlor epoxide	n.d.	0.04	0.05
Aroclor 1242	n.d.	0.01	1.00	alpha-Chlordane	n.d.	0.04	0.05
Aroclor 1248	n.d.	0.01	1.00	alpha-BHC	n.d.	0.001	0.05
Aroclor 1254	n.d.	0.01	1.00	beta- BHC	n.d.	0.005	0.05
Aroclor 1260	n.d.	0.01	1.00	delta-BHC	n.d.	0.005	0.05
Aroclor 1262	n.d.	0.01	1.00	gama-BHC (Lindane)	n.d.	0.001	0.05
Aroclor 1268	n.d.	0.01	1.00	gama-(Chlordane)	n.d.	0.005	0.05
Dieldrin	n.d.	0.01	0.10				

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REPORT OF ANALYSIS

Report Number: 12-144-2254

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORII
TRIP NUMBER EDXEJ050912

Date Reporte 7/31/2012
Date Receive 5/9/2012
Date Sample 5/9/2012

Lab number: 1989048 **Sample ID:** LS-S3 ELUTRIATE

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/18/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)	Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
4,4'-DDE	n.d.	0.003	0.10	Endosulfan I	n.d.	0.005	0.05
4,4'-DDD	n.d.	0.004	0.10	Endosulfan II	n.d.	0.003	0.10
4,4'-DDT	n.d.	0.009	0.10	Endosulfan sulfate	n.d.	0.002	0.10
4,4'-Methoxychlor	n.d.	0.01	0.50	Endrin	n.d.	0.004	0.10
Aldrin	n.d.	0.004	0.50	Endrin aldehyde	n.d.	0.004	0.10
Aroclor 1016	n.d.	0.08	1.00	Endrin ketone	n.d.	0.006	0.10
Aroclor 1221	n.d.	0.01	2.00	Heptachlor	n.d.	0.005	0.05
Aroclor 1232	n.d.	0.01	1.00	Heptachlor epoxide	n.d.	0.04	0.05
Aroclor 1242	n.d.	0.01	1.00	alpha-Chlordane	n.d.	0.04	0.05
Aroclor 1248	n.d.	0.01	1.00	alpha-BHC	n.d.	0.001	0.05
Aroclor 1254	n.d.	0.01	1.00	beta- BHC	n.d.	0.005	0.05
Aroclor 1260	n.d.	0.01	1.00	delta-BHC	n.d.	0.005	0.05
Aroclor 1262	n.d.	0.01	1.00	gama-BHC (Lindane)	n.d.	0.001	0.05
Aroclor 1268	n.d.	0.01	1.00	gama-(Chlordane)	n.d.	0.005	0.05
Dieldrin	n.d.	0.01	0.10				

Midwest Laboratories

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REPORT OF ANALYSIS

Report Number: 12-144-2257

Reported to:
US ARMY CORPS OF
ENGINEERS
DAVE JENSEN
CENWO-ED-HA
1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORING
TRIP NUMBER EDXDEJ050912

Date Reported: 7/31/2012
Date Received: 5/9/2012
Date Sampled: 5/9/2012

Low Level Analysis

Lab number: 1989039 **Sample ID:** LB-W1-MISSOURI RIVER OVERBURDEN WATER

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/15/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
Aroclor 1016	n.d.	0.0002	0.001
Aroclor 1221	n.d.	0.0003	0.001
Aroclor 1232	n.d.	0.0003	0.001
Aroclor 1242	n.d.	0.0003	0.001
Aroclor 1248	n.d.	0.0004	0.001
Aroclor 1254	n.d.	0.0003	0.001
Aroclor 1260	n.d.	0.0004	0.001
Aroclor 1262	n.d.	0.0004	0.001
Aroclor 1268	n.d.	0.0003	0.001
Dieldrin	n.d.	0.0002	0.001

Midwest Laboratories

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REPORT OF ANALYSIS

Report Number: 12-144-2254

Reported to:
US ARMY CORPS OF
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1616 CAPITOL AVE 5TH FLOOR
OMAHA NE 68102

For: (20061) US ARMY CORPS OF ENGINEERS
(402) 995-2310

PO/Proj. #: SPS-LSXBND-001
LITTLE SIOUX BEND ELUTRIATE MONITORI
TRIP NUMBER EDXEJ050912

Date Reporte 7/31/2012
Date Receive 5/9/2012
Date Sample 5/9/2012

Low Level Analysis

Lab number: 1989048 **Sample ID:** LS-S3 ELUTRIATE

Method: EPA 8081A/8082 **Units:** µg/L **Analyst:** nmh **Date of Analysis:** 5/18/2012

Analysis	Level Found	Method Detection Limit	Reporting Limit (µg/L)
Aroclor 1016	n.d.	0.0002	0.001
Aroclor 1221	n.d.	0.0003	0.001
Aroclor 1232	n.d.	0.0003	0.001
Aroclor 1242	n.d.	0.0003	0.001
Aroclor 1248	n.d.	0.0004	0.001
Aroclor 1254	n.d.	0.0003	0.001
Aroclor 1260	n.d.	0.0004	0.001
Aroclor 1262	n.d.	0.0004	0.001
Aroclor 1268	n.d.	0.0003	0.001
Dieldrin	n.d.	0.0002	0.001